EFFECTIVE USE OF DEFIBRILLATORS IN THE EMERGENCY CENTRE

Dr Pauline Louw
MBChB (Pretoria)

KRGPAU006

Part III MMed Emergency Medicine

Division of Emergency Medicine
University of Cape Town

TITLE

Effective use of Defibrillators in the Emergency Centre.

AUTHOR

Dr Pauline Louw
Division of Emergency Medicine, University of Cape Town

SUPERVISOR

Prof Lee Wallis
Head of Emergency Medicine, University of Cape Town

QUALIFICATIONS AND AFFILIATIONS OF AUTHOR

Dr Pauline Louw.
MBChB (Pretoria)
Division of Emergency Medicine, University of Cape Town

CONFLICT OF INTEREST AND FUNDING

None

ETHICAL APPROVAL

Obtained from the Research Ethics Committee
Reference number: 425/2008

PATIENT CONSENT

None needed.

CONTACT DETAILS OF CORRESPONDING AUTHOR

P Louw
PO BOX 1457
Milnerton
7435

Email: paulinelouw@vodamail.co.za
Cell: 083 609 9600

DECLARATION

I, Pauline Louw, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

Signed the 19th day of MAY 2009

at CAPE TOWN

Signed by candidate

Pauline Louw

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ACKNOWLEDGEMENTS

I would like to thank my family for their support and love during the completion of my Emergency Medicine registrar time and dissertation, especially also for my loving husband, Walter, for all his understanding and support.

All my gratitude and thanks goes to my clinical supervisor, Prof LA Wallis; thank you for all the advice and patience during the completion of the dissertation.

Maryn Viljoen, whose help with the interpretation and explanation of statistics was of great assistance. It made the process of understanding the complicated world of statistics much easier. Thank you for all the guidance and help.

Lastly, but most importantly, I would like to thank all the personnel working in the various Emergency Centres in the Western Cape that participated in the study. Without your involvement in the study, it could not have been completed.

ABREVIATIONS

AED	Automated external defibrillator
AICD	Automatic Internal Cardiac Defibrillator
ALS	Advanced Life Support
ACLS	Advanced Cardiac Life Support
AF	Atrial Fibrillation
APLS	Advanced Paediatric Life Support
ATLS	Advanced Trauma Life Support
BLS	Basic Life Support
CPR	Cardio-pulmonary resuscitation
COSMO	Community Service Medical Officer
EC	Emergency Centre
ECG	Electrocardiogram
EMSSA	Emergency Medical Society of South Africa
HPCSA	Health Professionals Council of South Africa
ICD	Implantable Cardioverter-Defibrillator
GP	General Practitioner
J	Joule
Kg	Kilogram
MO	Medical Officer
PEA	Pulseless Electrical Activity
SVT	Supraventricular Tachycardia
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia
WHO	World Health Organization

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Chapter 1

ABSTRACT

1.1 INTRODUCTION

In the Emergency Centre (EC) there are a number of essential items of equipment that are needed in the management of a wide variety of acute life-threatening emergencies. The defibrillator forms part of this equipment and should be available in all EC's. Although defibrillators are widely available in the Western Cape EC, it is unknown whether EC personnel have the skills and knowledge necessary to safely and effectively use a defibrillator.

The aim of this study was to establish the current level of EC personnel knowledge in the correct and effective use of defibrillators and determine whether the current level of knowledge is up to the standard that would be expected.

1.2 METHODS

An anonymous and voluntary audit was performed with the use of a questionnaire, completed by medical and nursing personnel working in Western Cape public sector EC's at district, regional and central hospital level.

1.3 RESULTS

In the study it was found that although all EC's had a defibrillator, knowledge in its use was lacking. Correct Joule settings were indicated by only 14% of personnel. For defibrillation 18% of personnel knew all the correct indications. Synchronized cardioversion knowledge was also poor, at only 6%.

1.4 CONCLUSION

Currently, not all personnel working in public sector EC's have knowledge and skills at the expected standard. Knowledge in the correct and effective use of defibrillators is lacking. Regular training and updates in defibrillator usage are necessary for all personnel working in an EC.

Chapter 2

INTRODUCTION

In the Emergency Centre (EC) there are a number of essential items of equipment that are needed in the management of a wide variety of acute life-threatening emergencies. Although the presence of the equipment in the EC is very important, other factors that need to be considered in determining the preparedness of the EC to deal with these conditions: for example, whether the equipment is in good working order, if regular calibration or testing of the equipment is done and whether the equipment is standardised in the EC and hospital.

The correct use of the equipment depends greatly on the training and experience of personnel. Regular in-service training is essential to ensure that personnel remain updated and build-up the necessary confidence to use the equipment correctly and effectively.

The defibrillator forms part of this essential equipment and should be available in all EC's. Although defibrillators are widely available in the Western Cape EC's, it is not known whether public sector EC personnel have the knowledge and skills necessary to safely and effectively use a defibrillator.

2.1 HISTORY OF DEFIBRILLATORS

2.1.1 DEFIBRILLATORS

Defibrillation or "shock-therapy" has been in use since the 19th century. Carl Ludwig's laboratory was one of the pioneers in the field of fibrillation and defibrillation. One of his students, M Hoffa, was the first to witness, document and induce ventricular fibrillation by an electrical stimulus in 1849; these findings were published in 1850. [1]

Prevost and Batelli, two physiologists from the University of Geneva in Switzerland, discovered in 1899 that an electrical stimulus applied to the heart of a dog in fibrillation can lead to conversion of the arrhythmia to a normal sinus rhythm. However it was only 48 years later that the first defibrillator came to light. A thoracic surgeon, Dr Claude Beck, used a defibrillator to save the first human life with defibrillation in 1947. The initial defibrillators only functioned with an open chest cavity with the "paddle-type electrodes" applied directly to the heart. His findings were published in the Journal of the American Medical Association in

1947, after which interest in defibrillation exploded and a wide range of research was performed in this new area of medicine and technology [1]

Figure 1: Defibrillator prototype model of Dr C Beck, 1947. This type of model was used in cases of open-chest defibrillation with spoons being used as electrodes. [2]

In the mid 1950's, closed-chest defibrillation devices were first used. They applied alternating current of more than 1000 Volts by means of externally applied electrodes. This groundbreaking work was performed by Dr V Eskin and A Klimiv in Frunze, USSR. [3] The first portable defibrillators on ambulances were introduced in the 1960's by the pioneer work of Prof. Frank Pantridge in Belfast. The first Automated External Defibrillator (AED) made its appearance in the late 1970's. [4]

With advances in technology defibrillators have also undergone a facelift and more state of the art, effective and user-friendly defibrillators are currently on the market. The importance of out-of-hospital arrest and improvement in survival after early defibrillation has also led to advances in the field with the manufacturing of AED that can be used by the public. Implantable Cardioverter-defibrillators (ICD) (also known as Automatic Internal Cardiac Defibrillator (AICD)) are also widely studied and in use in the present day.

2.1.2 PACING

Although defibrillators have been studied and used since the 19th century, pacing only made its appearance in the 20th century. The first attempts of external pacing were performed independently by two doctors a few years apart. Dr Albert Hyman in the USA and Dr Mark Lidwill of Australia were the pioneers in early pacing development. [5] Dr A Hyman's device consisted of a hand-cranked spring motor which turned a magnet to supply electrical impulses to the right atrium by means of a needle electrode placed inside the heart. [5-6] The first external pacer was developed and used by Dr Paul Zoll in the early 1950's although these devices were large, impractical and didn't function during power shortages; they were a starting point for further research.

Figure 2: The prototype pacemaker that was used by Dr A Hyman in the 1930's. [6]

The first internal pacemaker that was implanted in a patient occurred in 1958 by a Swedish doctor, Dr A Senning and his team. [5] Although the first implantable pacemaker only lasted for 3 hours it set off ground-breaking research. Over the next couple of decades research on implantable pacemakers was perfected. Today there are thousands of lives that have been saved and the quality of life of countless patients has been improved by the use of implantable pacemakers.

2.2 EARLY DEFIBRILLATION

Most cardiac arrests in adult patients are due to Ventricular Fibrillation (VF) or cardiac related causes. Early defibrillation has been shown to improve survival of patients presenting with cardiac arrest due to a ventricular arrhythmia. [7-15] Early defibrillation is thus an important part of the immediate treatment of these patients. (Combined with the other links

of the chain of survival for both in- and out-of-hospital cardiac arrest these include early recognition of cardiac arrest, early activation of help, early and effective CPR and early advanced life support interventions).[7]

It is widely documented in the literature that early defibrillation improves the outcome of patients presenting in cardiac arrest, and significant decreases in morbidity and mortality can be achieved. For every minute where there is a delay in defibrillation for a patient presenting with cardiac arrest with a shockable rhythm, the chances of survival decrease by 7-15%. [12- 14]

2.3 DEFIBRILLATOR GENERAL INFORMATION

In new guidelines AED's form part of Basic Life Support (BLS) that can be used by the public; while manual defibrillation, cardioversion and pacing all form part of Advanced Life Support (ALS) skills that can be performed by healthcare providers. [15] The defibrillator plays an important role, especially in patients presenting with shockable arrest rhythms. In cardiac arrest there are only two shockable rhythms: VF and Ventricular Tachycardia (VT) without a pulse.

Apart from defibrillation, the defibrillator also has various other functions including synchronized cardioversion and pacing. One of the unlabelled uses of the defibrillator is its use as a continuous cardiac monitor in unstable patients.

Defibrillators can be either manual or automated, while some defibrillators have both manual and automated capacity. Defibrillators currently function with one of two types of waveforms, namely monophasic or biphasic waveforms.

The current Joule (J) settings for defibrillators according to South African Resuscitation Council guidelines differ for mono- and biphasic defibrillators. [16] For monophasic defibrillators the Joule setting for defibrillation of a shockable rhythm is 360 J for adults and 4J/kg for children. Biphasic defibrillator Joule settings for defibrillation of a shockable rhythm in an adult differ and are dependent on the specific recommendations of the manufacturer of the defibrillator. The range of Joule settings are from 120-360 J, although 150 J is mostly used. Most of the defibrillators have a colour indication on the dial for the manufacturer's recommended Joule settings during defibrillation. In the event that the EC personnel are unsure, the manufacturer's defibrillation guide can be referenced or 150 J can be used as default setting.

Automated External Defibrillators have an important role in public-led resuscitation. They are becoming more available for use by the public in an attempt to improve survival after cardiac arrest. Internationally, AED's are widely available in public places including shopping malls, public gatherings and airports. In South Africa however the AED is less available. AED's are available for use on some intermediate life support ambulances in the Western Cape and larger public places. (This includes all the international airports).

All resuscitation and other equipment in an EC should be checked on a regular basis to ensure that it is in good working condition: this is especially applicable to defibrillators. [17] According to the Emergency Medical Society of South Africa (EMSSA) practice guideline EM008 for Defibrillators it is recommended that daily defibrillator testing should occur.[18] The outcome of the testing should also be documented. This is to ensure a working defibrillator at all times during an emergency when it is required.

2.4 CARDIOVERSION

Cardioversion can be either electrical or pharmacological and form part of the treatment strategy for rhythm control in patients presenting with a wide variety of dysrhythmias. The choice between the two above mentioned treatment modalities has been widely studied in the literature. [19]

Synchronized cardioversion implies that the delivery of the shock is timed or synchronized to occur during the QRS complex on the ECG,[15] thus avoiding the vulnerable period during the cardiac cycle which can induce VF if a shock is delivered (which corresponds to the T-wave on the ECG). Synchronized cardioversion energy settings are usually lower compared to defibrillation.

Synchronized cardioversion is indicated mostly for hemodynamic unstable patients with peri-arrest rhythms (unstable tachycardias with a pulse). The unstable tachycardias include VT with a pulse and Supraventricular Tachycardia (SVT) due to re-entry, Atrial Flutter and Atrial Fibrillation (AF).

2.5 PACING

Pacing is a life-saving skill that is used mostly in the treatment of patients presenting with hemodynamic unstable bradycardias or in overdrive pacing in specific tachycardias. [20-22] Some defibrillators have built-in pacing capacity although separate pacing machines are also available.

Emergency pacing is recommended in patients presenting with bradycardia with a pulse who are either unresponsive to atropine or are heamodynamically unstable (including patients with a third degree heart block). [23] It is not recommended for use in patients without a pulse presenting with asystole or PEA.

There are various pacing options available in addition to the use of the defibrillator and these include temporary pacing in the form of transcutaneous or transvenous pacing and permanent pacing in the form of implantable pacemakers. [23]

2.6 DEFIBRILLATORS IN THE WESTERN CAPE

In the Western Cape there are 40 public sector hospitals, all of which have a defibrillator available; many primary care facilities including day hospitals and clinics do not have a defibrillator available on the premises. It is widely believed that the use of a defibrillator in the various hospitals differ and it may depend on a number of factors including the location and size of the hospital, skill and experience of the personnel as well as the disease profile of the community that the hospital serves.

Larger hospitals located in the Metropole are believed to be more likely to use a defibrillator frequently. However, even if a defibrillator is seldom used in a hospital, it is still vital to maintain the knowledge and skill necessary to use the defibrillator when the need arises.

The regular testing of defibrillators in the EC is the responsibility of the senior EC sister. These tests should occur on a daily basis and the outcome of the test should be documented.

In the Western Cape EC the main responsibility for the use of defibrillators lies with the doctors although some of the more senior sisters also have the training and experience to use a defibrillator correctly. It is perceived that the use of defibrillators falls outside the scope

of practice for nursing personnel but no formal documentation was found to validate this statement during the literature research.

As with any other item or equipment in the EC, the necessary training and regular updating of knowledge and skills are of paramount importance for personnel to maintain the standard of care required for that skill. Defibrillators can be life-saving if they are used correctly and effectively. Currently in South Africa there is no formal research to indicate whether EC personnel are at the required level of care, if they had adequate training and if they have the knowledge and skills to use a defibrillator correctly and effectively.

Chapter 3

AIM

The **aim** of this study is to assess the availability of defibrillators and the current level of knowledge among healthcare personnel in Western Cape public sector ECs on the correct and effective use of defibrillators.

In order to achieve this aim, the study **objectives** can be divided into objectives regarding the equipment and knowledge of the healthcare personnel working in the EC.

Objectives with regard to the equipment currently in the Western-Cape EC's:

- To establish whether defibrillators are present in each Western-Cape EC.
- To establish if daily defibrillator testing occurs and whether it is documented in a dedicated log.
- To establish whether monophasic or biphasic defibrillators are in use in the EC.
- To establish if pacing leads and pads are available in the EC or hospital.

Objectives with regard to healthcare personnel's knowledge on defibrillators:

- To establish if all healthcare personnel have had formal training in the use of defibrillators.
- To establish the level of knowledge and skills in the functions of the defibrillator including the indications for defibrillation and cardioversion
- To establish whether the correct Joule setting are currently used for defibrillation in the Western-Cape EC's.

Chapter 4

LITERATURE REVIEW

4.1 LITERATURE SEARCH

The following databases were searched:

- Medline 1966 – 2009
- EMBASE 1982 - 2009
- Google
- Google scholar

The search strategy included a wide range of keywords related to defibrillators and resuscitation. Only English language articles were reviewed.

Keywords used in the search included the following:

- Defibrillation
- Resuscitation algorithms
- Monophasic and Biphasic
- Pacing
- Cardioversion
- Automated External Defibrillation or AED

All articles or research papers that were retrieved during the literature search were reviewed for their feasibility, relevance and applicability for use in this study. The bibliographies of the retrieved articles were also scrutinized for further relevant articles.

A total of 128 relevant articles were reviewed, of which only 72 was were deemed useful for the study.

4.2 INTERNATIONAL LITERATURE

4.2.1 EARLY DEFIBRILLATION

Cardiovascular disease is a global health problem and forms part of the burden of disease in both developed and developing countries. [24] Cardiovascular disease also remains one of

the most common causes of death in developed countries. [25] In witnessed sudden cardiac arrest the most frequent initial rhythm is VF. [15]

Early defibrillation [7-11, 15] is an important step to improve survival after cardiac arrest. For every minute delay to defibrillate a patient presenting with a shockable rhythm, the chances of survival decrease by 7-15%. [12-13,15]. Thus if a patient presenting in VF cardiac arrest is only defibrillated for the first time 10 minutes after onset of arrest, the patient will effectively have little chance of survival despite the most heroic attempts at CPR and advanced life support.

Defibrillators form an integral part of the National and International Algorithms for resuscitation of patients presenting with either arrest or peri-arrest rhythms. [16, 26-27]

The 2005/6 Resuscitation guidelines presented some changes to the practice of CPR in an attempt to improve survival. In the new guidelines various changes have been implemented to different aspects of resuscitation. With regards to defibrillation, a single defibrillation shock is recommended; compared to three stacked shocks in the previous guidelines. After delivery of a shock immediate CPR is advised for two minutes before evaluating the rhythm. [15-16, 26]

After in-hospital cardiac arrest caused by ventricular arrhythmia; expert guidelines suggest that defibrillation should occur in less than 2 minutes to improve survival rates. [14] This emphasises again the importance of early defibrillation not only to improve survival, but also to increase the chance of return to spontaneous circulation.

There are various reasons for delays in defibrillation in-hospital, including cardiac arrest that occurs afterhours, or cardiac arrest in a patient in an unmonitored bed, reduced availability of trained medical personnel to use the defibrillator, poor access or unavailability of a defibrillator, or delays due to failure to recognize and treat ventricular arrhythmia which warrants defibrillation. [14, 28-29]

Many challenges for timely defibrillation occur both in-hospital and pre-hospital; however the pre-hospital challenges has not been investigated for the purposes of this study.

4.2.2 DEFIBRILLATOR STANDARD OF CARE

According to international literature defibrillators form part of the standard equipment that needs to be present in all EC's. [27,30] However the defibrillator does not form part of the generic essential emergency equipment list for resuscitation at first referral health facilities as published by the World Health Organization (WHO). [31] Although equipment should be present, it is not always standardized and often suboptimal with a wide variation in the quality and type of equipment in various clinical areas even in the same hospital. [32]

Personnel working in EC's should be strongly encouraged to remain up to date with current resuscitation knowledge and skills as well as attend various courses to improve their knowledge and skills; these include basic as well as advanced life support courses [33-35]. There are numerous training courses available.

The knowledge and skills of personnel working in the EC regarding defibrillators as well as other equipment used in resuscitation should be updated and re-education should occur at regular intervals to maintain the standard level of knowledge and skill required. [34-38] Skill retention and knowledge has been shown to be poor if regular training and updates do not occur. [39-41]

4.2.3 AED IN PRIMARY HEALTH CARE AND GENERAL PRACTITIONER OFFICES

In addition to EC's there are obvious benefits of having defibrillators available in other healthcare settings.

Internationally the recommendation for the minimum emergency equipment needed in primary care offices vary greatly and there are currently limited international guidelines available to stipulate what equipment should be present. [34] However in view of the ease of use and proven efficacy of AED's, this piece of equipment can be valuable in a primary care facility.

With less than 1% of cardiac arrests occurring in a general practice [42] various General Practitioners (GP's) may well object against investing in an expensive piece of equipment, which potentially will never be used and only gather dust. However, easy to use alternatives such as AED's are relatively inexpensive and as they may be lifesaving, represent a solid investment.

Various studies have looked at placement of AED's in GP practices. GP surgeries can be divided into low-, medium- and high incidence for cardiac arrest depending on the patient population and disease profile of the patients attending the practice. [43] This may influence the decision to invest in an AED to ensure early defibrillation in practices with a high risk or incidence for cardiac arrest.

4.2.4 PUBLIC ACCESS DEFIBRILLATION

The public can play an important role in saving lives by performing rapid defibrillation with the use of an AED especially in patients presenting with sudden cardiac arrest due to VF. [25, 44-48].

However, AED's cannot be placed in all public places. With planning and research it is possible to establish which public places have the highest risk for cardiac arrest and where most patients will benefit from having an AED available in a public place. [49]

Internationally the AED has become more and more available for use by the public and studies have shown that with no or minimal training AED's can be used successfully to save lives and improve survival after cardiac arrest by non-medical personnel. [25, 44-48] Gundry showed that even sixth-grade children can use AED's without any previous instruction or training. [50]

Some of the studies have used various public places to demonstrate the effectiveness of public access defibrillation. Page showed that an AED aboard commercial aircrafts is effective and life-saving. [8]

Valenzuela showed by using security officers in a casino, that rapid defibrillation by non-medical personnel save lives. [46] They further confirmed previous research results by demonstrating increased survival rates if the interval between the patient collapse and first defibrillation attempt is short and indicated that intervals of less than three minutes are associated with the highest survival rates.

Apart from the public, emergency medical services including the police force can also play an important role to improve early access to defibrillation in an attempt to strengthen the links of the chain of survival and ultimately improving the outcome of patients after cardiac arrest. A variety of studies have shown a benefit from equipping police vehicles with AED's.

[51-55] Police responders often reach a scene before emergency medical services and can help to decrease the time to defibrillation.

Groh however found that police responders equipped with an AED took longer to reach calls for a patient with cardiac arrest than other calls. [56] AED deployment in police responders thus will require buy in from the police to increase their confidence of police responders to use the AED and decrease their concerns or fears for personal liability if the AED is used. [51, 56]

Although public access defibrillation has made a big impact on early defibrillation and improving survival of patients presenting with sudden cardiac arrest, cardiac arrest in public places only constitute 20% of all out-of-hospital cardiac arrest cases. More than 80% of out-of-hospital sudden cardiac arrest occurs in private or residential settings. [15, 57] Despite this there is currently no clear evidence for or against home AED programs.

4.2.5 DEFIBRILLATION WAVEFORMS

The initial or conventional defibrillators that were manufactured were mostly monophasic defibrillators. With advances in research and technology there are two waveforms currently available: monophasic and biphasic. [15] There have been a large number of human and animal studies published comparing monophasic and biphasic waveforms. [58-64]

Conventional defibrillators are monophasic, with either damped sinusoidal or truncated exponential waveforms. [15] Monophasic waveforms are unidirectional and require higher energy levels to terminate ventricular arrhythmia. Monophasic defibrillators deliver high energy at escalating energy levels from 200 J to 360 J.

Biphasic waveforms are bidirectional with both positive and negative flow of current. Biphasic defibrillators use a biphasic truncated exponential or a rectilinear biphasic waveform. [15] Biphasic waveforms require less energy to successfully terminate ventricular arrhythmias. [62, 65]

Various studies have shown that defibrillation with biphasic waveforms is effective, safe and lower energy levels can be used to terminate ventricular arrhythmia compared to conventional higher energy monophasic waveforms. It also has an equivalent or higher response to terminate VF and achieve return to spontaneous circulation compared with monophasic waveforms. [57-62, 66-67]. However Schneider showed that although biphasic was

superior to monophasic defibrillation in terms of termination of VT, return to spontaneous circulation and improved neurological outcome at discharge, the survival to discharge from hospital was similar in both groups. [60]

In one animal study it was also found that biphasic defibrillation results in less impairment of post-resuscitation myocardial function compared to monophasic defibrillation. [62] Martens found that biphasic defibrillators have a more than 90% first shock efficacy in terminating ventricular arrhythmia (especially VF) while monophasic waveforms had only a 54-77% first shock efficacy. [58]

Currently biphasic defibrillator guidelines suggest a low-energy setting (the actual value varies between manufacturers) compared to the escalating high-energy settings when using monophasic defibrillators. However, for biphasic defibrillation the optimum initial and subsequent doses have an insufficient evidence base for definitive statements. [15, 57]

A small study by Stiell investigated the use of standard 150 J with escalating higher energy regimens for biphasic defibrillation in out-of-hospital cardiac arrest. Half of their patients only needed one shock to terminate VF, while the other half with refractory VF showed a benefit in using escalating higher-energy regimens with increased termination of VF and return to an organized rhythm. [68] However further large studies are needed before changing current guidelines.

Triphasic waveforms are currently under investigation, mostly using animal models. The research is limited and remains experimental at present. [4]

4.2.6 NURSE-INITIATED DEFIBRILLATION

It is widely perceived by nursing personnel that the use of defibrillators falls outside their scope of practice. However this perception might be nurse-driven rather than suggestions from guidelines for the scope of practice of nurses.

The Australian College of Emergency Nurses recommend that all sisters with ALS competency should be able to use manual defibrillators, while AED use and training should be extended to include enrolled nurses. [69] The College of Nurses of British Columbia also indicate in their scope of practice for registered nurses, that registered nurses may defibrillate using an AED. [70]

Nurses are often the first responders in hospital wards: Nurse-initiated defibrillation improves survival of patients presenting with in-hospital cardiac arrest. [71-72]. Defibrillation should form part of the expected skills to be performed by nursing personnel in their scope of practice rather than an extended skill, especially personnel working in the EC. [71-72]

Previous studies have shown poor knowledge and skill retention after CPR and defibrillation training in healthcare providers including nursing personnel. [39-41] Educational programmes, in-service training and regular updates in current best-evidence practice are necessary to improve retention of knowledge and skills. These activities can occur by using a wide variety of teaching aids that include audiovisual aids, manikin and resuscitation equipment-based scenarios, self-study and recognized resuscitation courses. [40]

A change of attitude and willingness from the nursing personnel are necessary to ensure that educational programmes are a success and to make certain that defibrillation starts to be perceived as a routine skill of a South African nurse.

4.3 SOUTH AFRICAN LITERATURE:

In South Africa there are currently limited morbidity and mortality data. The Burden of Disease Research Unit of the Medical Research Council found that in 2000 HIV and AIDS (30%) were the top causes of mortality, while cardiovascular disease (17%) followed second. [73] Similar to developed countries, in South Africa cardiovascular diseases and sudden cardiac arrest also forms part of the most common causes for morbidity and mortality of the population.

Currently in South Africa there is very little research specific to defibrillators and their use in the EC. There are also limited data on the present availability and use of AED's for public-access defibrillation. These limitations leave room for potential future research or studies to be performed in the South African setting.

Claassens studied the chain of survival at Gymnasiums in the Pretoria area; he found that half of the Gymnasiums that participated in the study had an AED on the premises with adequate training of the staff to initiate CPR and use the AED.[74] Defibrillators and Transcutaneous pacing both form part of the essential equipment list for EC's as published by the Emergency Medical Society of South Africa (EMSSA). [75] (Appendix A) Other authors advise that doctors wanting to work in the Emergency Medicine environment must have appropriate equipment including a defibrillator with pacing capacity. [76]

Defibrillation forms an integral part of the basic and advanced life support algorithms from the Resuscitation Council of Southern Africa. [16] (Appendix B) In the 2006 guidelines early defibrillation and effective chest compressions with minimal interruptions are emphasized. Three stacked shocks have been replaced by a single shock every two minutes if the rhythm is shockable, followed by immediate CPR at a ratio of 30:2 after each shock. [77] The dosages used during defibrillation depend whether a monophasic or biphasic defibrillator is used.

Nurse-initiated defibrillation is currently not practiced in the vast majority of the hospitals in the Western Cape due to a perception that defibrillation is not in the scope of practice for nursing personnel. However no documentation was found to validate this statement during the South African Literature search on the scope of practice guidelines for nursing personnel from the various authorities in nursing.

In South African literature there is an EMSSA guideline published dedicated specifically to defibrillation that was developed January 2009. [18] Practice guideline EM008, (Appendix C) details the standard of care for the use of defibrillators. This practice guideline is applicable to both pre-hospital and hospital environments and is suggested to be implemented and used as a guide to determine if EC's are currently at the expected standard of care for defibrillator use.

Chapter 5

METHODOLOGY

A questionnaire was used to determine the current knowledge and use of defibrillators in the Western Cape EC's.

5.1 ETHICAL APROVAL

Ethical approval was obtained from the University of Cape Town's Research Ethics Committee, reference number: 425/2008.

5.2 STUDY POPULATION

All public hospitals with an EC in the Western Cape were included. Private hospitals and primary health care facilities (including community day centres and community health centres) were excluded from the study.

The Western Cape is divided into five Geographic Service Areas or regions. These consist of three rural areas (Paarl, George and Worcester) and two metropole areas (Metro East and Metro West). Each area has various district (Level 1) hospitals which refer to a specific regional (Level 2) hospital.

There are three central (Level 3) hospitals (Grootte Schuur Hospital, Red Cross Children's War Memorial Hospital and Tygerberg hospital). There are four regional hospitals (George, New Somerset, Paarl and Worcester hospital), 26 rural district hospitals and seven metropole district hospitals in total. (Table 2)

All healthcare personnel working permanently in the EC at each facility were identified and approached after consent was obtained from the facility's superintendants and/or the head of the EC. The personnel were invited to participate in the study on an anonymous and voluntary basis and refusal to participate in the study did not prejudice the personnel in any way.

DISTRICT HOSPITALS IN THE WESTERN CAPE	
METROPOLE	**RURAL**
1. Eerste River Hospital 2. False Bay Hospital 3. GF Jooste Hospital (Manenberg) 4. Helderberg Hospital (Somerset West) 5. Karl Bremer Hospital (Bellville) 6. Victoria Hospital (Wynberg) 7. Westfleur Hospital (Atlantis)	1. Alan Blythe Hospital (Ladysmith) 2. Beaufort West Hospital 3. Caledon Hospital 4. Ceres Hospital 5. Citrusdal Hospital 6. Clanwilliam Hospital 7. Hermanus Hospital 8. Knysna Hospital 9. Laingsburg Hospital 10. Montagu Hospital 11. Mossel Bay Hospital 12. Murraysburg Hospital 13. Nelspoort Hospital 14. Otto du Plessis Hospital (Bredasdorp) 15. Oudsthoorn Hospital 16. Radie Kotze Hospital (Piketberg) 17. Lapa Munnik Hospital (Porterville) 18. Prince Albert Hospital 19. Riversdale Hospital 20. Robertson Hospital 21. Stellenbosch Hospital 22. Swartland Hospital (Malmesbury) 23. Swellendam Hospital 24. Uniondale Hospital 25. Vredenburg Hospital 26. Vredendal Hospital

Table 1: District hospitals in the Western Cape.

5.3 COLLECTION OF DATA

Due to logistics and travel distances between the various hospitals in the Western Cape, not all hospitals could be visited in person by the Principal Investigator to hand the forms out as well as to explain the process for completion of the questionnaire.

Hospitals located in the **metropole** were visited in person. After explanation of the aim of the study, personnel working in the EC were invited to sign a consent form prior to completing the questionnaire in an honest and open way without any help from colleagues. After completion of the questionnaire the consent and completed questionnaires were handed in separately to maintain confidentiality. Permission and help were requested from the matron in charge of the EC to explain and hand the forms out to the other shifts working in the EC. These forms were then collected at a later stage.

Data collected from hospitals located in the **rural** hospitals occurred via post. The matron of the hospital was requested to assist with data collection. All communication occurred telephonically as well as electronically. Defibrillation questionnaires were posted to the various rural hospitals; with prepaid return envelopes to send the completed forms back in. Regular contact was maintained with these hospitals to monitor the progress of the study.

5.4 DEFIBRILLATION QUESTIONAIRE

The defibrillation questionnaire consisted of three pages, and is included as Appendix D.

On the first page background information was given on the study including the aim of the questionnaire, who should participate in the study and why personnel should participate. The second page consisted of a consent form to be signed by all personnel participating in the study while the last page consisted of the questions related to defibrillators.

Personnel who agreed to participate in the study were requested to complete the consent form as well as the questionnaire, after which the pages were handed in separately to maintain confidentiality.

The defibrillation questionnaire consisted of 18 questions with areas for extra comments. Sixteen questions had tick boxes present while the remaining two questions had a dedicated area to write the correct answer.

The defibrillation questionnaire consisted of the following:

- Job description:
  For the nursing personnel the job description was divided as either a sister or a nurse. A nurse encompassed all levels of nursing including a staff nurse, auxiliary nurse and nurse assistant. The doctor's job description was divided into 4 categories including: medical officer (including all levels of experience from junior medical officer to chief medical officer), registrar in a specialist discipline, community service medical officer and intern.

- Defibrillator presence:
  Three of the questions were specific on the presence of a defibrillator in the EC and/or hospital as well as whether there is an AED present in the hospital.

- Defibrillation testing:
  A question was asked on whether defibrillation testing occurs in the EC and who perform these tests.

- Defibrillator training:
  A yes or no question was asked on whether previous defibrillator training was received by the personnel member completing the questionnaire.

- Defibrillator experience:
  Some of the questions were directed towards previous exposure and experience with a defibrillator. This included questions on whether a defibrillator was either used by the specific personnel member or witnessing it being used by someone else. A time frame when the last time the personnel member defibrillated was given as 1 week ago, month ago, year ago or area to mark if the personnel member was unsure when the last time occurred.

- Defibrillation specific knowledge:
  Questions relating directly to defibrillators and defibrillation consisted of the following:
  - Presence of mono- or biphasic defibrillator in the EC.
  - Specific Joule settings used for the defibrillator by the personnel member.
  - Indications for defibrillation

- Indications for synchronized cardioversion

- Pacing specific questions:
  The last part of the defibrillation questionnaire asked questions specific to pacing and included the following: Presence of pacing facilities either in the EC or hospital and whether pacing was performed or witnessed by the personnel member previously.

- Comments:
  The questionnaire also provided space for the participants to fill in any further comments regarding the questionnaire or defibrillation.

5.5 DEFIBRILLATOR HOSPITAL INFORMATION

For the hospitals that participated in the study, background information was needed on the presence of defibrillators in the specific EC. This information served as a control to confirm the answers on the completed defibrillation questionnaires of the participants working in the particular EC. The hospital defibrillation information sheet is included as Appendix E.

The information needed from the various EC's included the following:

- Total number of personnel working in the EC including nursing personnel and doctors.
- Presence of a defibrillator in the EC and in the hospital.
- Location of the defibrillator in the EC.
- Mono- or biphasic defibrillator present in the EC.
- AED present in the hospital or EC.
- Whether defibrillator testing occurs in the hospital and how often does this occur.
- Who is responsible for the defibrillator testing?
- Is there a dedicated book present in the EC in which the defibrillator testing is documented in?
- Presence of pacing facilities in the hospital and in the EC.

The above information was documented on a Hospital Defibrillator Information Sheet after interviewing the head of the EC or the matron of the EC. For metropole hospitals the defibrillators were also inspected in person by the Principal Investigator.

5.6 DATA ANALYSIS

Data were collected on a Microsoft Excel ® database version Redmond, Va 2007, on a password protected work computer.

Data analyses were performed with the help of a biostatistician using SAS Version 9.1.3. Simple descriptive statistics were used where appropriate. For categorical data, frequencies and percentages were calculated. Means and standard deviation or medians and percentiles were calculated for numerical data.

To evaluate statistical differences between groups, appropriate p-values were calculated. Fisher's exact test and Chi-square statistics were used for differences in categorical data. Kruskal-Wallis test was used for differences between median values.

Chapter 6

RESULTS

40 Public sector hospitals with an EC in the Western Cape were approached. Two refused to participate while 11 did not return the defibrillation questionnaire forms in time and therefore were excluded. 27 Hospitals (67.5%) were analyzed.

6.1 SAMPLE DEMOGRAPHICS

378 forms were retrieved; 12 (3.5%) were excluded due to lack of signed consent. 366 forms were analyzed. The response rate varied by institution, from 11.5 to 100% (Mean 53.8% (Standard deviation 22.4%)) as depicted in Figure 3.

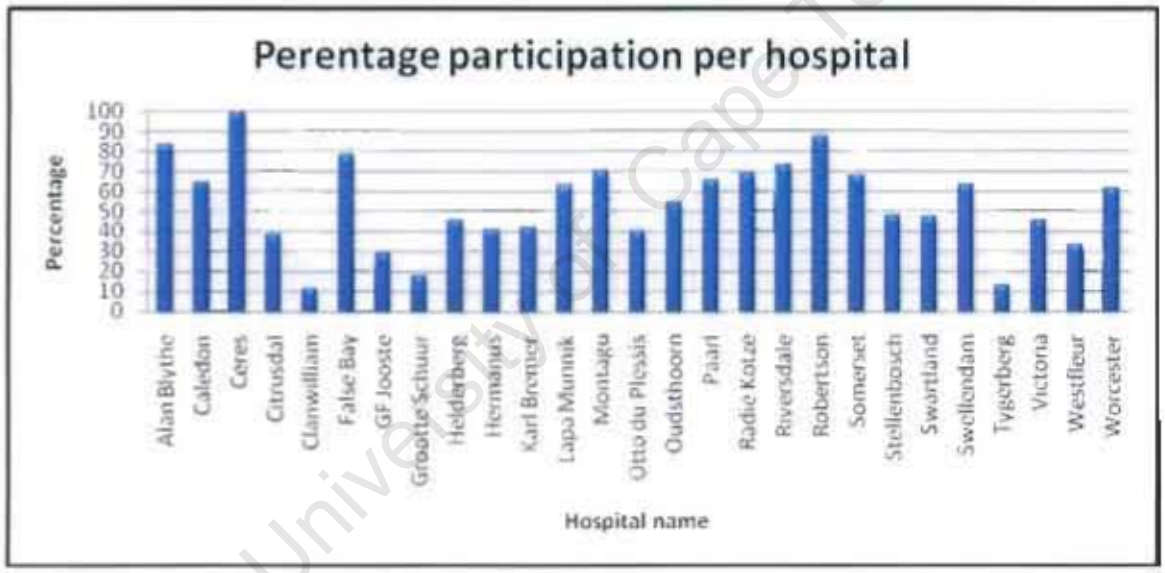


Figure 3: Percentage participation of individual hospitals.

Of the hospitals that participated in the study, 22 (81.5%) were district hospitals (Table 2), three (11.1%) were regional hospitals (Table 3) and two (7.4%) were central hospitals (Table 4).

DISTRICT HOSPITALS INCLUDED IN THE STUDY	
METROPOLE	**RURAL**
1. False Bay Hospital 2. GF Jooste Hospital (Manenberg) 3. Helderberg Hospital (Somerset West) 4. Karl Bremer Hospital (Bellville) 5. Victoria Hospital (Wynberg) 6. Westfleur Hospital (Atlantis)	1. Alan Blythe Hospital (Ladysmith) 2. Caledon Hospital 3. Ceres Hospital 4. Citrusdal Hospital 5. Clanwilliam Hospital 6. Hermanus Hospital 7. Lapa Munnik Hospital (Porterville) 8. Montagu Hospital 9. Otto du Plessis Hospital (Bredasdorp) 10. Oudsthoorn Hospital 11. Radie Kotze Hospital (Piketberg) 12. Riversdale Hospital 13. Robertson Hospital 14. Stellenbosch Hospital 15. Swartland Hospital (Malmesbury) 16. Swellendam Hospital
DISTRICT HOSPITALS EXCLUDED FROM THE STUDY	
METROPOLE	**RURAL**
1. Eerste River Hospital	1. Beaufort West Hospital 2. Knysna Hospital 3. Laingsburg Hospital 4. Mossel Bay Hospital 5. Murraysburg Hospital 6. Nelspoort Hospital 7. Prince Albert Hospital 8. Uniondale Hospital 9. Vredenburg Hospital 10. Vredendal Hospital

Table 2: District hospital participation in the study.

REGIONAL HOSPITALS INCLUDED	REGIONAL HOSPITALS EXCLUDED
1. New Somerset Hospital 2. Paarl Hospital 3. Worcester Hospital	1. George Hospital

Table 3: Regional hospital participation in the study.

CENTRAL HOSPITALS INCLUDED	CENTRAL HOSPITALS EXCLUDED
1. Groote Schuur Hospital 2. Tygerberg Hospital	1. Red Cross Children's Hospital

Table 4: Central hospital participation in the study.

Of the hospitals that were excluded from the study, one (7.7%) was a central hospital (Table 4), one (7.7%) was a regional hospital (Table 3) and 11(84.6%) were district hospitals (Table 2).

The participation between the various regions in the Western Cape also showed variation, with Metro West, Paarl and Worcester areas having the best representation in the study.

REGION	NUMBER OF HOSPITALS	HOSPITAL PARTICIPATION
George	12	3 (25%)
Metro East	4	3 (75%)
Metro West	6	5 (83%)
Paarl	10	8 (80%)
Worcester	8	8 (100%)
Total:	**40**	**27**

Table 5: Variation in region participation in the study.

68% (Standard Deviation 22%) of forms were completed by nursing personnel. The distribution of seniority of the personnel is shown in figure 4.

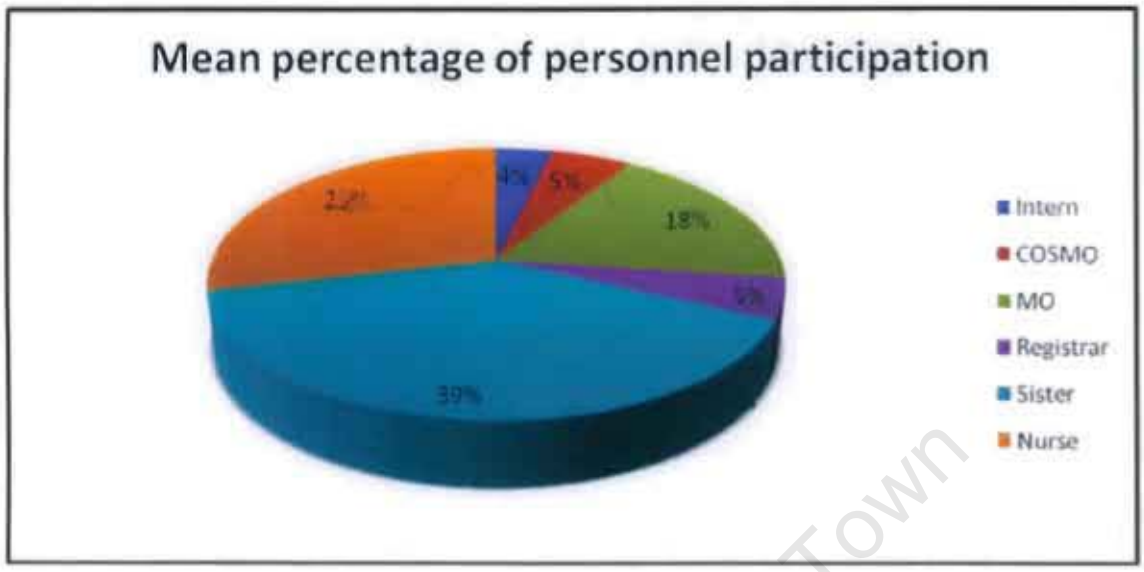


Figure 4: Mean percentage of personnel participation by seniority.

Figure 5 illustrates the participation of personnel by seniority for each level care.

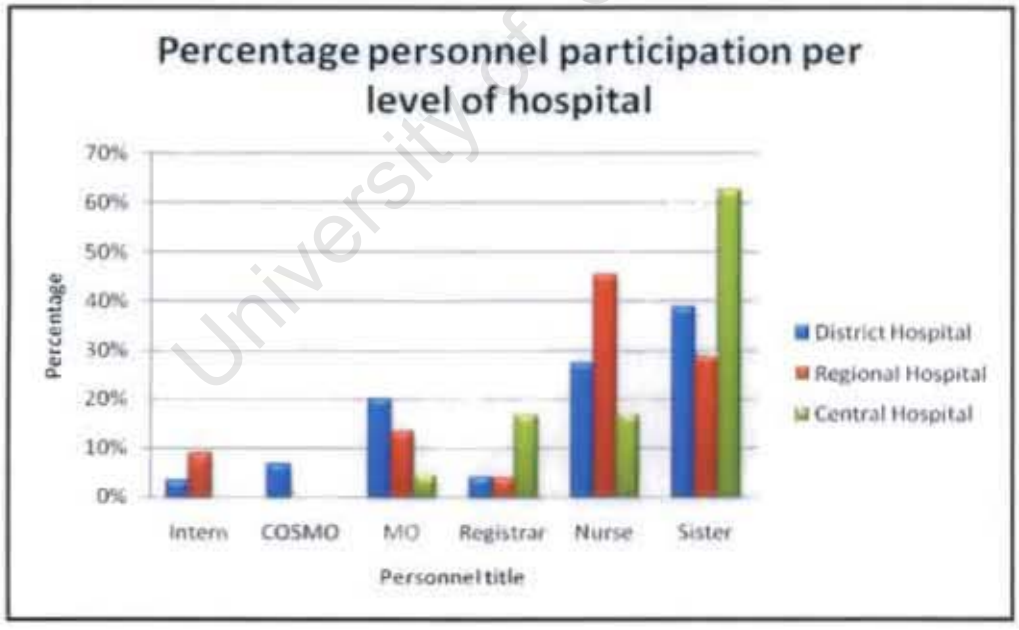


Figure 5: Comparison between level of hospital and personnel participation by seniority.

6.2 EQUIPMENT IN THE EC

All 27 hospitals had a defibrillator present in the EC, the number of defibrillators varied from one (16 hospitals, 59.3%) to more than three (one hospital, 3.7%). None of the EC's had an AED present, although some of the defibrillators were stated to have an automated capacity.

Most of the district hospitals had only one (68%) defibrillator while all of the regional hospitals had two (100%) defibrillators. Only one central hospital had more than three defibrillators present. (Figure 6)

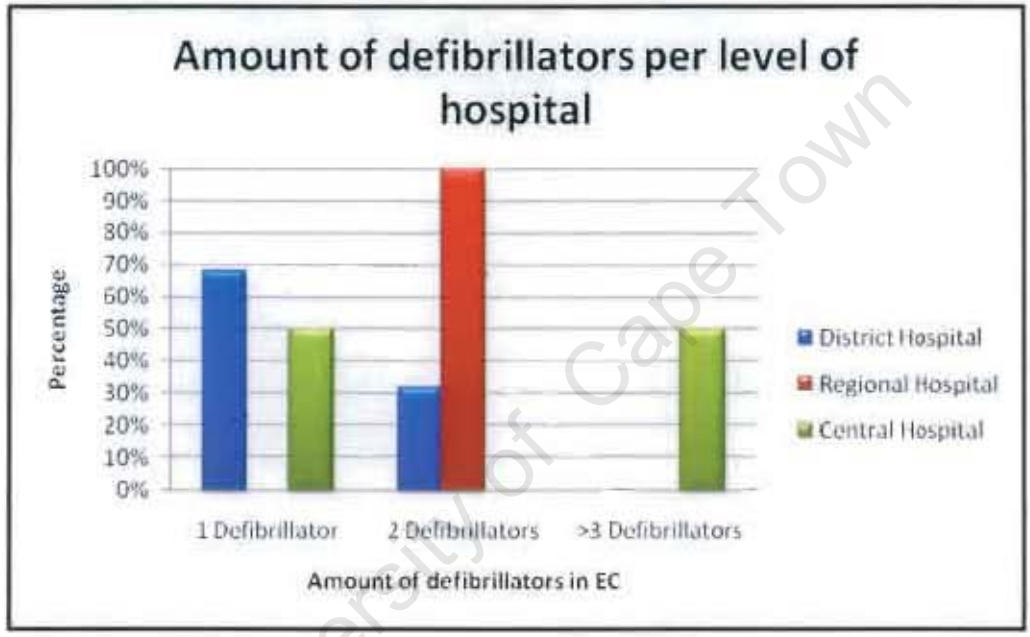


Figure 6: Comparison of amount of defibrillators per level of hospital.

Defibrillator specification varies between facilities. 67% of hospitals had biphasic, 15% had monophasic and 18% had both mono- and biphasic defibrillators in the EC. Figure 7 illustrates the mean percentage difference between the types of defibrillators present for each level of care.

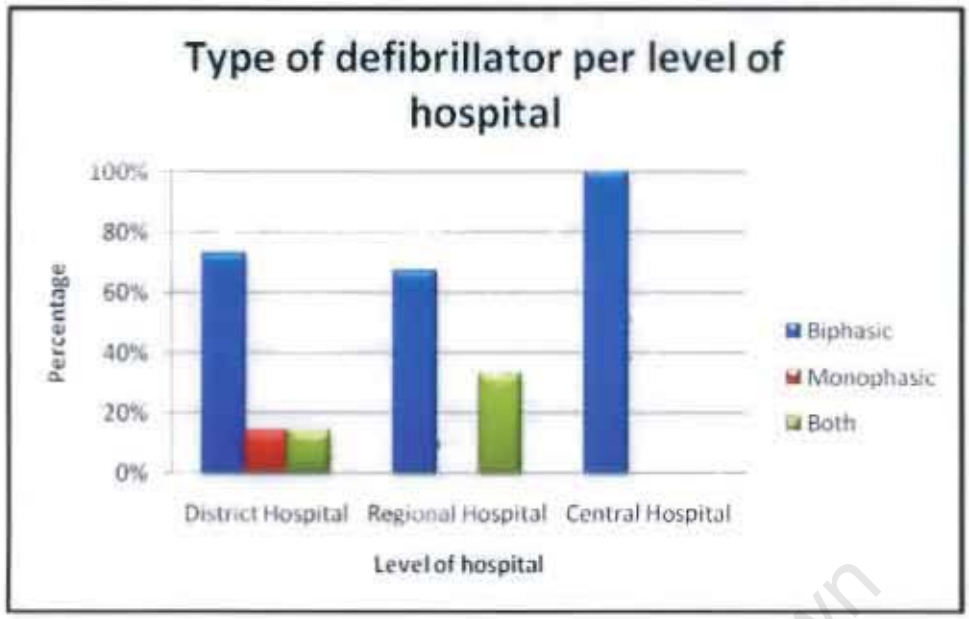


Figure 7: Comparison of type of defibrillator per level of hospital.

37% of hospitals had pacing capabilities in the EC. The majority of hospitals without pacing consisted of district hospitals.

Defibrillator tests occur in 67% of EC's. However, there is wide variation in the frequency of testing (Figure 3). Although 52% of defibrillators are tested daily, only 26% of these tests are documented in a dedicated log. Where testing takes place, it is the responsibility of the nursing personnel in all the hospitals except one which makes use of the hospital's workshop personnel.

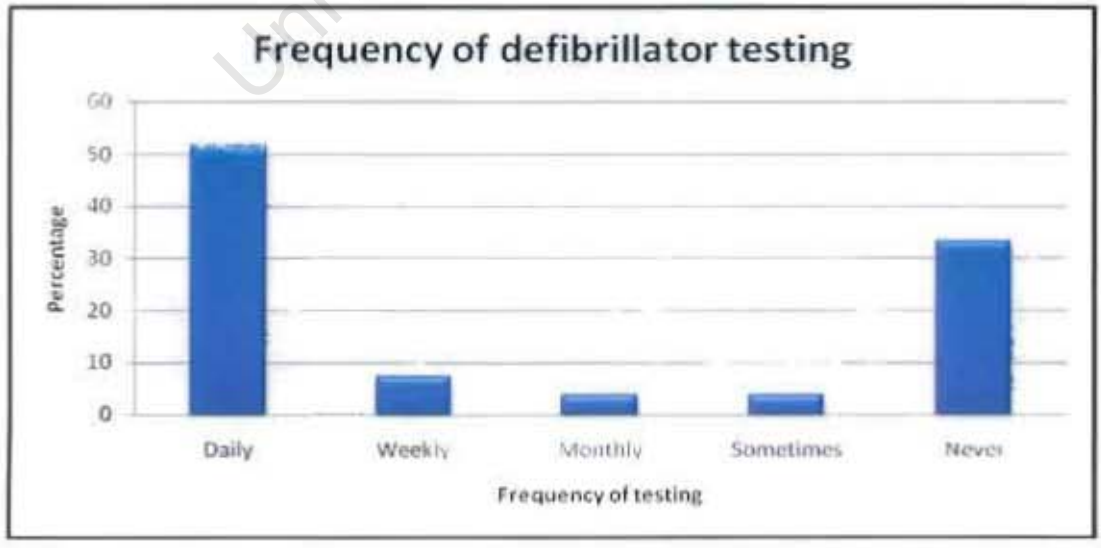


Figure 8: Frequency of defibrillation testing.

There was no significant difference in the frequency of testing by level of hospital (p=0.44) or by district (p=0.73).

Table 6 illustrates the difference between the doctors, sisters and nurses regarding their correct percentage knowledge on the presence of equipment in their EC.

COMPARISON CORRECT PERCENTAGE KNOWLEDGE OF EC PERSONNEL			
	DOCTORS	SISTERS	NURSES
Presence of defibrillator in EC	99%	98%	93%
Defibrillator testing in EC	35%	48%	56%
Person responsible for testing	58%	60%	35%
Type of defibrillator in EC	55%	45%	27%
Pacing in EC	56%	61%	56%

Table 6: Comparison of knowledge of personnel regarding their EC equipment.

6.3 EXPERIENCE IN THE EC

58% of study participants had no previous training in using a defibrillator. Nursing personnel received the least training: only 13% of nurses and 30% of sisters received previous training compared with 88% of doctors.

There was no statistical difference in exposure of previous training by EC level. Training exposure was 41% in district hospitals, 45% in regional hospitals and 47% in central hospitals. (Figure 9)

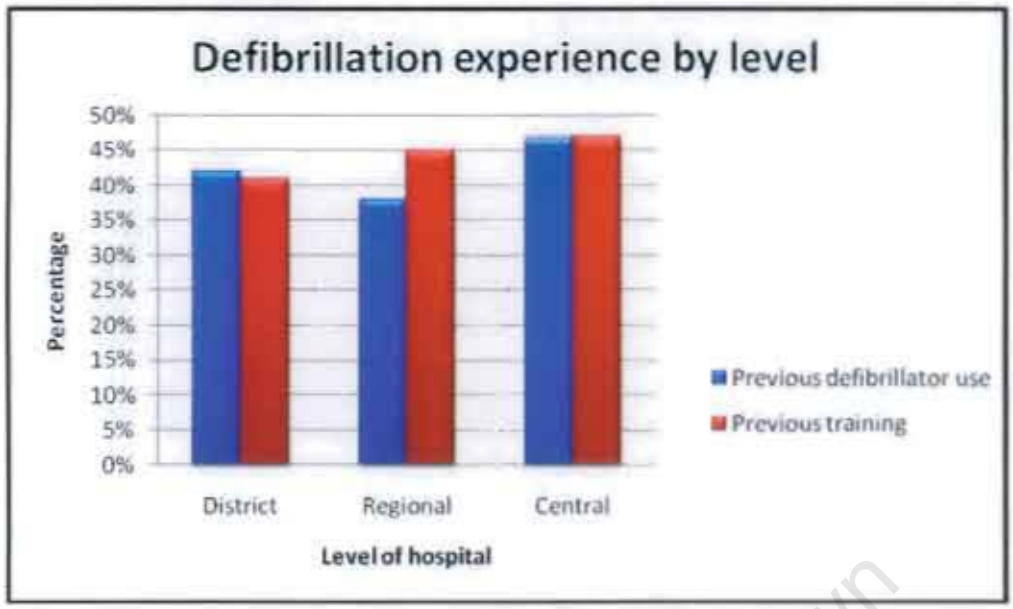


Figure 9: Comparison of defibrillator experience between levels of hospitals.

Figure 10 illustrates the percentage of defibrillator exposure by region.

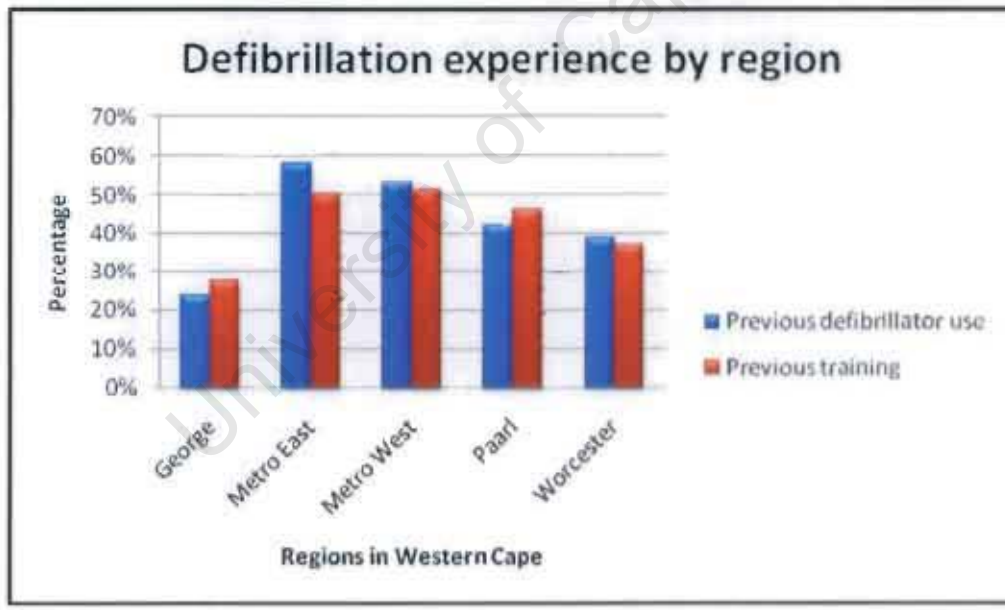


Figure 10: Comparison of defibrillator experience between regions of Western-Cape.

58% of personnel had not used a defibrillator before, although 88% had witnessed a defibrillator being used. Only 17% of personnel had paced a patient before, and 46% had witnessed pacing being performed.

6.4 KNOWLEDGE IN THE EC

6.4.1 PERSONNEL KNOWLEDGE

96% of study participants knew that there was a defibrillator present in their EC; however only 42% knew which type of defibrillator was present. 58% were correctly aware that their EC had pacing capabilities.

Three main areas of knowledge were tested: correct use of Joule settings, indications for defibrillation and indications for synchronized cardioversion.

Only 14% of EC personnel were aware of the correct Joule setting for their defibrillator (Figure 11). 36% were incorrect, although the majority did not answer.

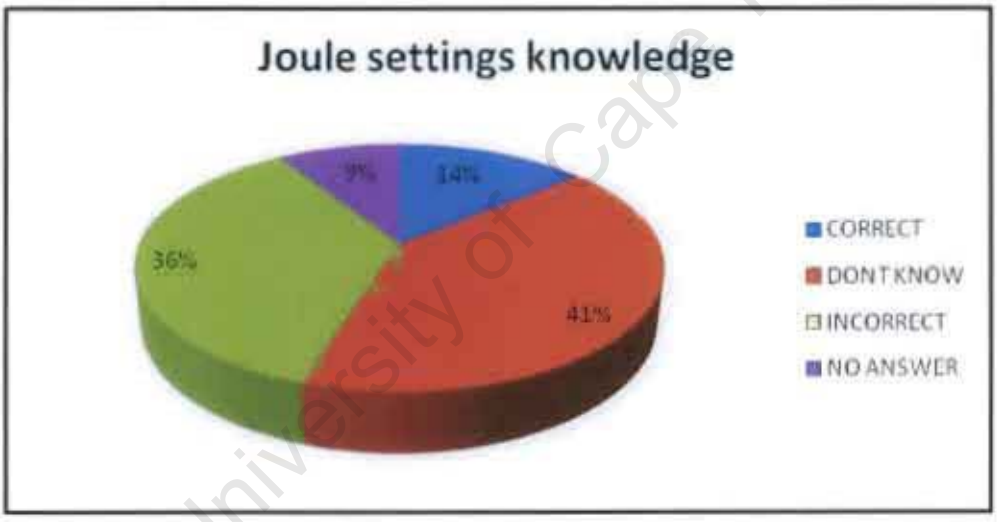


Figure 11: Percentage Joule setting knowledge in the EC.

Figure 12 shows the results regarding knowledge of indications for defibrillation. Only 18% knew all the indications compared to 59% of incorrect answers.

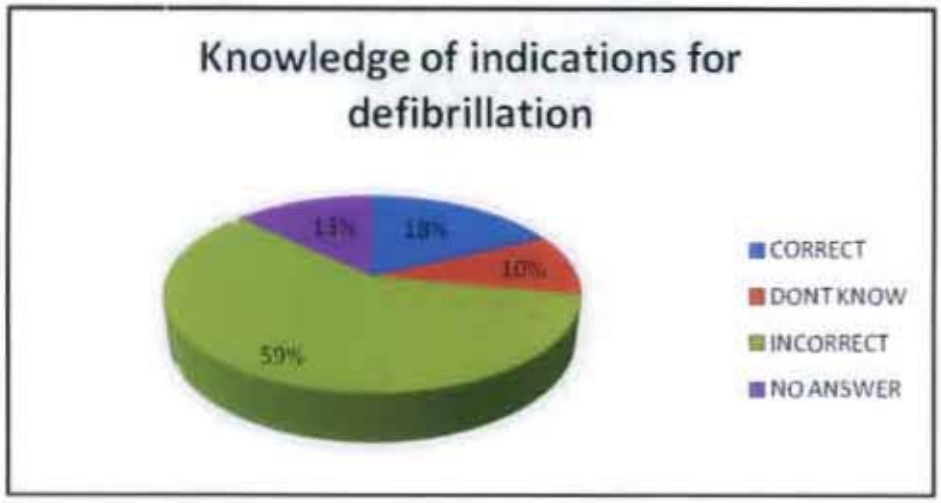


Figure 12: Percentage knowledge of indications for defibrillation in the EC.

Only 6% of personnel were aware of the correct indications for synchronized cardioversion (Figure 13)

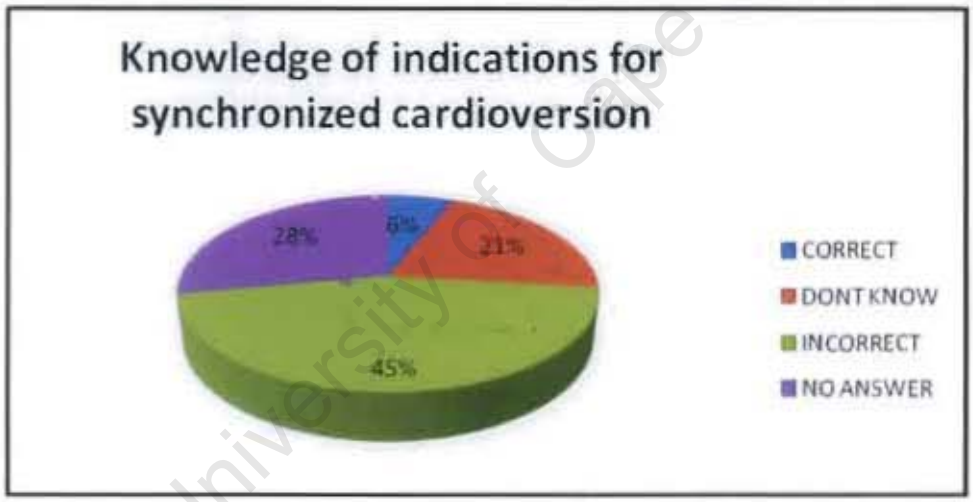


Figure 13: Percentage knowledge of indications for synchronized cardioversion in the EC.

6.4.2 DEFIBRILLATOR KNOWLEDGE BY LEVEL OF CARE

Personnel knowledge was compared by the level of the facility. Figure 14 shows the results for these comparisons by hospital level.

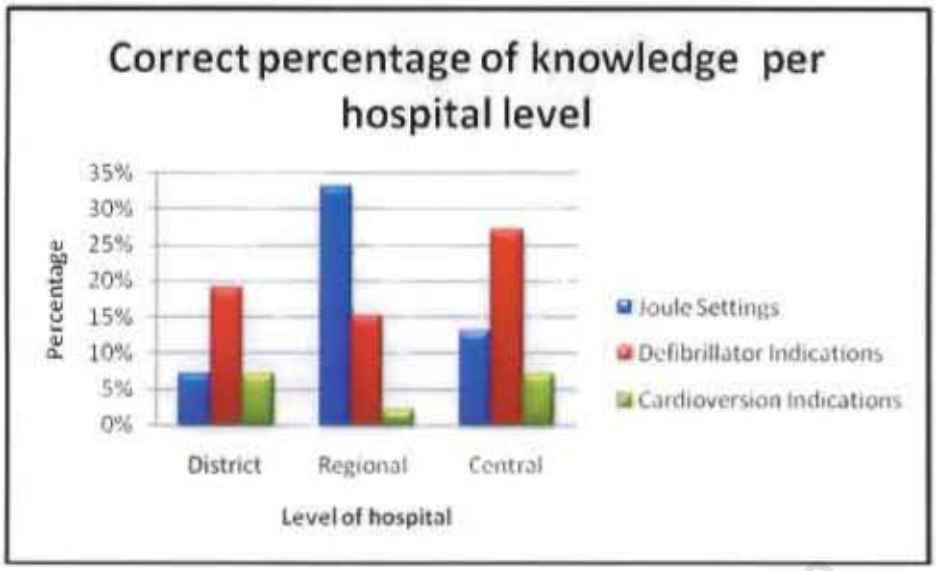


Figure 14: Defibrillator knowledge by level of hospital.

Defibrillator indication knowledge was the best in central hospitals (27%) compared to district (19%) and regional hospitals (15%). For synchronized cardioversion, both central and district hospitals had 7% correct knowledge compared to only 2% for regional hospitals.

6.4.3 DEFIBRILLATOR KNOWLEDGE BY REGION

Defibrillation knowledge was compared by geographic region (Figure 15). Joule setting knowledge was the best in Paarl (25%) and the worst in Metro East (4%). Defibrillation indications knowledge was the best in Metro East (35%) and Metro West (32%) while George region had the lowest percentage of knowledge (8%). For synchronized cardioversion Metro East had the highest percentage knowledge (12%) compared to George (0%).

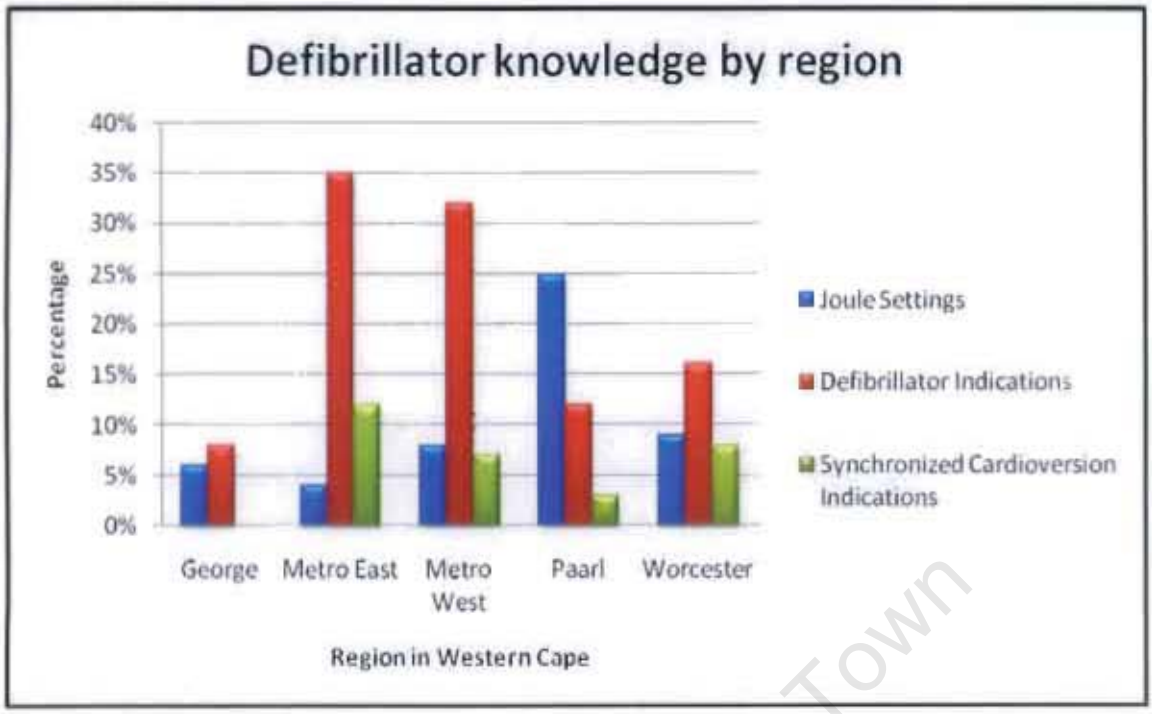


Figure 15: Defibrillator knowledge by region.

Knowledge surrounding the indications for both defibrillation and synchronized cardioversion was the best in the Metropole regions compared to rural regions.

6.4.4. DEFIBRILLATOR KNOWLEDGE BY SENIORITY OF PERSONNEL

Figure 16 shows the differences in defibrillator knowledge by level of personnel seniority.

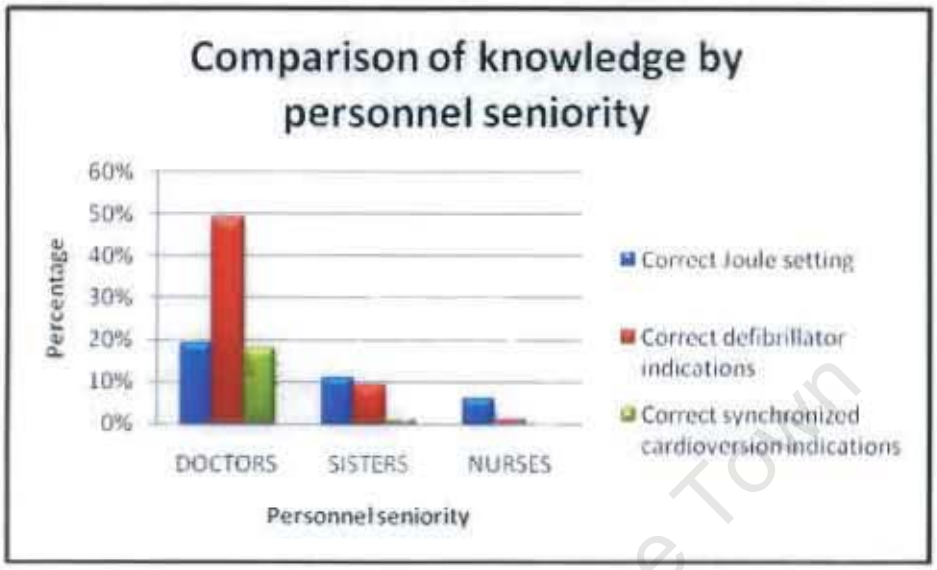


Figure 16: Comparison of defibrillator knowledge by seniority.

There was no significant difference between the seniority for personnel in the correct Joule setting ($p=0.05$). However there were a significant difference in the correct indications for defibrillation ($p<0.0001$) and synchronized cardioversion ($p<0.0001$) between the seniority of personnel.

Doctors had the best knowledge for both the indications of defibrillation (49%) and synchronized cardioversion (18%), while nurses had the least knowledge in all areas of defibrillator use.

Chapter 7

DISCUSSION

7.1 NUMBER OF HOSPITALS

All 40 public sector hospitals with an EC in the Western Cape were approached to participate in the study. Of these hospitals 38 gave permission: 11 were excluded due to delayed return of defibrillation questionnaire forms.

The 27 hospitals that participated in the study represent a good cross section of the Western Cape hospital base, including rural and metropole hospitals across all three levels of care and five regions.

7.2 DEFIBRILLATION QUESTIONNAIRE

The defibrillation questionnaire consisted of one page with tick boxes to indicate the choice of the answer and only two questions requiring a written answer. This meant that the time needed to complete the questionnaire was very short; most personnel reported taking less than two minutes to complete. It did not negatively impact on patient care.

7.3 DEFIBRILLATION IN EC's

The use of defibrillators is widely perceived to be an emergency procedure that will mostly be performed in an EC, Intensive care setting or by cardiac arrest teams. This sample reflects the personnel that will most often come into contact and make use of defibrillators. This would imply that their use of and knowledge of defibrillators should be better than their colleagues in a non-emergency environment. [78-79]

7.4 EQUIPMENT IN THE EC

Equipment is not standardized, with alarming variation from EC to EC. (and in some cases within the EC.) South African resuscitation guidelines recommend a biphasic defibrillator with the Joule settings determined by the manufacturer. Variation in equipment leads to the potential for confusion when the defibrillator is needed.

Pacing is an emergency procedure that may be lifesaving for patients presenting with unstable bradydysrythmias especially third degree heart block. [20-22] Taking into consideration the distances between some of the rural hospitals to their closest referral hospital, the fact that only 37% of EC's had pacing may influence the morbidity and mortality of patients in need of this treatment. Pacing is now part of the Western Cape Department of Health's Package of Care for district Hospitals [80] and therefore should be present in all EC's.

It is important that all personnel working in an EC should be familiar with their equipment and know how to use the equipment correctly and effectively to improve patient care and outcome. Apart from knowledge on the use of equipment, it is important that equipment is tested on a regular basis [17-18]. Only 67% of hospitals tested their equipment, and many of these were very infrequent.

Defibrillation testing occurred on a daily basis in 52% of EC's, however only 26% of these hospitals had a dedicated log in which the testing was documented. In the absence of documentation of testing, the facility is defenceless in a medicolegal setting.

7.5 DEFIBRILLATOR KNOWLEDGE

Over half of the personnel surveyed had no previous training in defibrillation; only 30% sisters and 13% nurses had any training compared to 88% of doctors. Although previous training is important, [33-38] it is the retention of knowledge which is more important. [39-41] This study indicates poor knowledge regarding defibrillators throughout all levels of care and in all personnel seniorities.

In the study 96% of personnel were aware that their EC had a defibrillator, however less than half of the personnel knew which type.

7.5.1 JOULE SETTING

The correct Joule setting is dependent on the type of defibrillator. For monophasic defibrillators escalating higher energy-dose settings can be used, or 360 J [16] Biphasic defibrillator Joule settings depend on the manufacturer specifications and range from 120-360J. However, the manufacturers of all Defibrillators present in the study recommend a dose of 150J.

Only 14% of personnel knew the correct Joule setting to use for their EC's Defibrillator. This may well have implications for patient care and outcome if incorrect Joule settings are used when defibrillating a patient. Effective defibrillation without delays improves survival rates of patients. [7-15] In the absence of knowledge unnecessary delays may occur or incorrect dosages may alter survival rates.

7.5.2 DEFIBRILLATION INDICATIONS

Defibrillation has only two indications: VF and Pulseless VT. Participants were requested to indicate the indications on the questionnaire. Correct answers implied that both indications were written. If only one of the two indications was written, it was marked as incorrect.

Only 18% or personnel that participated in the study knew the correct indications for defibrillation. While nursing personnel may argue that defibrillation is outside their scope of practice, all doctors working in an EC should know the indications for defibrillation. Only 49% of doctors knew the correct indications (34% knew one of the indications). The lack of knowledge despite 88% receiving previous training indicates a problem with skill retention and suggests that updates should occur at regular intervals to improve retention of knowledge and skills. [39-41]

7.5.3 SYNCHRONIZED CARDIOVERSION INDICATIONS

Synchronized cardioversion is indicated for two main groups of tachydysrhythmias (SVT and VT with a pulse). Only 6 % of personnel knew both of the indications while 28% knew one of the indications. This was the highest for doctors, although a very poor 18% knew both of the indications compared to 55% who knew one of the indications.

7.6 LIMITATIONS

This study has several limitations, related to completion of defibrillation questionnaires anc the determination of the correct number of personnel working in the EC.

7.6.1 QUESTIONNAIRE

With the large number of hospitals and four different nursing shifts to cover, supervision of personnel completing the defibrillation questionnaire forms was impractical. It is possible that some personnel copied answers from others or looked up the correct answers.

Personnel may also have chosen not to complete the defibrillation questionnaire if they did not know the answers. However, this would tend to bias the results towards more favourable outcomes which suggest that the defibrillator knowledge answers represent the best case scenarios.

7.6.2 PARTICIPANTS

Refusal to participate and delays in receiving the defibrillation questionnaire forms resulted in 13 hospitals being excluded from the study. Of the hospitals that were excluded one were central, one regional and 11 district hospitals. (10 rural and one metropole district hospital) District hospitals that were excluded were spread across the geographic regions with George region having the least participation.

There is no reason to believe that the hospitals that were excluded would have performed any differently from the hospitals whose results have been indicated, although this hypothesis has not been tested.

7.6.3 PERSONNEL NUMBERS

Determination of accurate numbers of personnel staffing the EC's was almost impossible for some rural district hospitals. Not all the hospitals have dedicated EC nursing or medical personnel and therefore determination of the correct denominator was impossible. Therefore, for some rural district hospitals the total healthcare personnel of the hospital was used as the denominator. Management were asked to have all healthcare personnel complete the questionnaire forms if they worked in the EC before.

At central and regional hospitals dedicated EC personnel exist and therefore calculation of the denominator was easier. The impact of agency personnel and absenteeism was not investigated in this study.

The study represents just one half of the EC personnel in 27 of the Western Cape hospitals although the participation was as low as 11% in one hospital. The under representation of personnel in certain hospitals may have influenced the significance of the study for that particular hospital, but as a representative sample with all other hospitals for the Western Cape this is of less significance.

7.7. COMPARISON WITH OTHER STUDIES

No published studies were found during the literature research that investigated the correct knowledge and use of defibrillators in EC's to compare the results of this study. Unpublished studies may exist on this topic.

However, Einav investigated the resuscitation skills of on-call physicians in a tertiary referral centre with the use of a simulated VF cardiac arrest scenario and tested their knowledge by requesting them to write the current treatment protocols for BLS and VF. In the study it was found that knowledge was lacking, with only 31% of the physicians being able to use the defibrillator correctly and only 25% knew the guidelines correctly or nearly correctly. It was also recommended that regular training and updates in resuscitation should occur. [82]

West studied GP's on call with regard to their equipment and knowledge in treatment of VF. He found that a significant portion did not have the appropriate equipment including a defibrillator. Their knowledge in the treatment of VF was also lacking with only 31% able to state the correct initial management of VF and 16% knew the local resuscitation guidelines. [83]

Although both studies did not occur in an EC, the results also showed that healthcare providers' knowledge and skills in the use of emergency equipment and treatment of life-threatening arrhythmias is lacking and that regular training and updates are mandatory. The above study findings are thus in line with the findings of this study's data.

7.8 SUMMARY

Defibrillators are a life-saving piece of equipment if used for the right indications at the right time and the right dose. Early defibrillation is known to improve survival of patients presenting with sudden cardiac arrest due to shockable rhythms. [12-14] Adequate knowledge and skills are of paramount importance to prevent unnecessary delays that might alter patient outcome. [33-38]

Hospital CEO's must ensure that defibrillators are standardized, that daily testing occurs and is logged in a dedicated log [18] and that personnel receive regular updates and training. Personnel working in the EC's in this study do not have the minimum level or standard of knowledge when compared to South African practice guidelines. [18] Resuscitation algorithms [16] must be available for personnel working in the EC to provide a visual aid.

Nurse-initiated defibrillation can be life-saving, and nursing personnel must be encouraged to add defibrillation to their scope of practice as an expected rather than extended skill. [69-72, 81] This will need a change in mind-set from the nursing personnel working in the EC's in the Western Cape public health sector.

7.9 IMPLICATIONS

All hospitals had defibrillators but there was no standardization, even within individual EC's. Pacing despite being part of the package of care for all level of hospitals, was absent from most EC's. Personnel defibrillator knowledge was very poor.

Equipment must be standardized, pacing provided, algorithms displayed and personnel training and updates provided for all EC's. Hospitals must take responsibility to ensure that all personnel are at the minimum national standard [18].

Chapter 8

CONCLUSIONS

The main aim of this study was to assess the availability of defibrillators and the current level of knowledge among healthcare personnel working in Western Cape public sector EC's regarding the correct and effective use of defibrillators.

This study found that while all hospitals had defibrillators available in their EC, equipment was not standardized, and testing was poorly done. In some hospitals both mono- and biphasic defibrillators were present. Few hospitals had pacing in the EC.

Knowledge regarding the use of defibrillators was very poor, and is a major concern with regards to provision of effective care for emergency patients.

There is an urgent need for a provincial roll-out of training in defibrillator usage.

Chapter 9

RECOMMENDATIONS

In an attempt to improve service delivery and healthcare to the Western Cape population the following recommendations are made:

1. DEFIBRILLATION

- All EC healthcare providers must be able to use a Defibrillator correctly and effectively as outlined in the EMSSA practice guideline EM008.[18] (Appendix C)
- Regular audits should be undertaken to assess improvements in defibrillator care provision.

2. PROTOCOLS

- The EMSSA guideline [18] should be distributed to all public sector EC's in the Western Cape.
- Resuscitation Algorithms should be displayed next to each Defibrillator in all EC's. (Appendix B)
- Amendments should be made to nursing scope of practice to include defibrillation as an essential skill.

3. EQUIPMENT

- Defibrillators should be standardized across all EC's to avoid confusion and simplify training and skill retention.
- Daily defibrillator testing must occur, with documentation of the outcome of the test in a dedicated log.

4. TRAINING AND CONTINUING EDUCATION:

- All healthcare providers working in EC's should have current knowledge in defibrillation. This is best achieved through regular in-service training and updates.
- Training to be repeated regularly to ensure skills retention.

5. RESEARCH:

- Further audits are recommended to include Private Hospitals, Emergency Medical Services and Primary Health Care facilities.

APPENDICES

A. EMSSA Emergency Centre Equipment list. Practice guideline EM004, December 2008.

B. South African Resuscitation Council Algorithms:

- Advanced Life Support Algorithm
- Recommended Defibrillator settings in Cardiac Arrest
- Adult emergency arrhythmia management algorithm.

C. EMSSA Defibrillator practice guideline. EM008, January 2009.

D. Defibrillation Questionnaire.

E. Hospital Defibrillator Information sheet.

APPENDIX A: ***EMSSA Emergency Centre Equipment list.***

Practice guideline EM004, August 2008.

Emergency Medicine Society of South Africa

PRACTICE GUIDELINE
EM004

EMERGENCY CENTRE EQUIPMENT

This Practice Guideline sets out the minimum recommended equipment for an Emergency Centre.

It should be read in conjunction with Practice Guideline EM005: Recommended Drugs for Emergency Centres.

Excluding the cover page, this Practice Guideline is **4** pages.

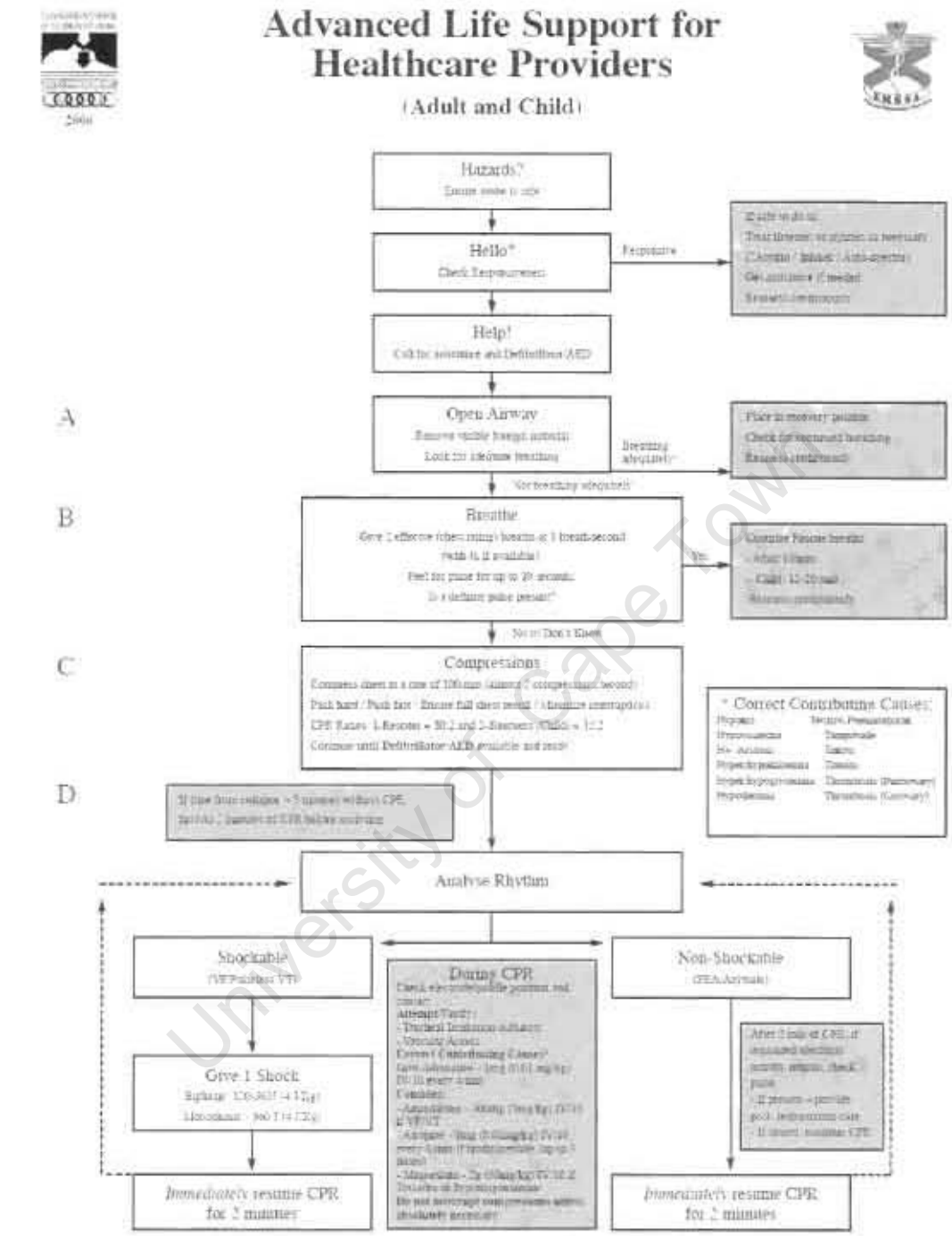
Date of publication:	August 2008
Date of review:	July 2010
Responsible committee member:	Prof Lee A Wallis

DEVICES TO OPEN AND PROTECT AIRWAY	
Laryngoscope set	handle with adult & paediatric blades, spare bulbs & spare batteries
Tracheal tubes	uncuffed (sizes 2.5 – 5.5mm)
	cuffed (sizes 3.0 - 8.5mm)
Water-soluble lubricant / KY jelly	
10 ml syringe	
Tape or equivalent to tie tube in place	
Meconium adaptor / aspirator	
Oropharyngeal airways	sizes 000 - 5
Nasopharyngeal airways	sizes 3 – 7
Tracheostomy tubes	sizes 00 – 6
DEVICES TO CONFIRM TRACHEAL INTUBATION	
Oesophageal detector device	
End tidal CO_2 monitoring	include single use colorimetric devices
EQUIPMENT FOR DIFFICULT INTUBATION	
Introducers for ET tubes	adult & paediatric stylets
Magill's forceps	adult & paediatric
Laryngeal masks	sizes 1 – 5
Cricothyroidotomy set	
Gum elastic bougie	adult & paediatric
DEVICES TO DELIVER OXYGEN AND TO VENTILATE PATIENTS	
Bag valve ventilation devices	with oxygen reservoir & adult, paediatric & neonatal masks
Oxygen delivery devices	partial rebreather masks, nebulizer masks, nasal prongs and T-piece
Oxygen supply	with flow regulator and oxygen tubing
Portable ventilator	
PEEP valve	with adaptor for bag valve device
EQUIPMENT FOR DECOMPRESSION OF THE THORAX	
Chest decompression sets	**minimum of a 14G Jelco**
Intercostal drains	sizes 10 – 36
	with scalpel, dissecting forceps, bottles

EQUIPMENT TO DIAGNOSE AND TREAT CARDIAC DYSRHYTHMIAS	
ECG monitor defibrillator	with conductive paste or pads, paddles, electrodes & razor
12 lead ECG monitor	
Cardiac arrest board	
Transcutaneous pacing ability	
DEVICES TO GAIN INTRAVASCULAR ACCESS	
I.V. cannulae	14-24G and appropriate strapping
Packs and lines for central venous access	
Needles and syringes	1-50ml
Sharps container	
Paediatric intraosseous needles	
Adult intraosseous needles	or bone marrow needles
High flow infusion catheters	8.5F
EQUIPMENT FOR THE SAFE INFUSION OF FLUIDS AND BLOOD	
I.V. administration sets	including blood administration sets, high flow sets & buretrol
Fluid warmer	
Umbilical vein catheters	
EQUIPMENT FOR MONITORING AIRWAY, BREATHING AND CIRCULATION	
Stethoscope	
Pulse oximeter	with adult & paediatric probes
Non invasive blood pressure monitoring device	including paediatric & large adult cuff sizes
Thermometer	including low reading capability
Blood glucose testing	
Collection tubes for investigations	
Automatic blood pressure device	with battery back-up
Doppler	

APPROPRIATE HARDWARE	
Heavy duty scissors to cut clothing	
Drip stand or equivalent hanging device	
Suction devices and suction catheters	rigid & flexible tips
Paediatric Broselow tape	
Therapeutic heating source	
Fixation devices	adult & paediatric semi-rigid cervical collars
	head blocks,
	spine boards
	restraining devices
	blankets & towel rolls
Universal precautions	gloves, goggles, gowns & face masks
Maternity delivery pack	
Cord clamps	
Suture material	
Resuscitation trolley	capable of high Fowlers and Trendelenberg
Limb traction device	
Wire cutters	
Vacuum mattress, Scoop stretcher	
Thoracotomy set	
APPROPRIATE TUBES AND CATHETERS	
Urinary catheters	sizes 8 – 18
Nasogastric tubes	sizes 5 – 18
Drainage bags	
Lumbar puncture set	
Medication stickers	
Resus Council Algorithms	
Resuscitation documentation record	

APPENDIX B: ***South African Resuscitation Council Algorithms:***



2006

Recommended Defibrillator Energy Settings in Cardiac Arrest

(Adult and Child)

Paediatric Patients (Pre-Puberty)
Monophasic & Biphasic Defibrillators - 4 Joules/kg (1st and subsequent shocks)

Adult Patients (Post-Puberty)
Monophasic Defibrillators - 360 Joules (1st and subsequent shocks)
Biphasic Defibrillators - As per Manufacturer's recommendations (See Table)

Defibrillator Make	Distributor in SA	Biphasic Waveform	Recommended Energy Setting in Cardiac Arrest (Joules)			
			1st Shock	2nd Shock	Subsequent Shock	Paed
H P / Heartstart	Philips	BTE	150 J	150 J	150 J	4 J/kg
Laerdal/Heartstart	Survival	BTE	150 J	150 J	150 J	4 J/kg
Life-Pak	Medtronic	BTE	200 J	300 J	360 J	4 J/kg
MRL	Welch Allyn	BTE	150 J	200 J	300 J	4 J/kg
Nihon Kohden	SSEM	BTE	150 J	200 J	270 J	4 J/kg
Powerheart AED	SSEM	BTE(VE)	200 J	300 J	360 J	4 J/kg
Responder	Medhold	BTE(VE)	200 J	300 J	360 J	4 J/kg
Zoll	Stat Medical	Rectilinear	120 J	150 J	200 J	4 J/kg

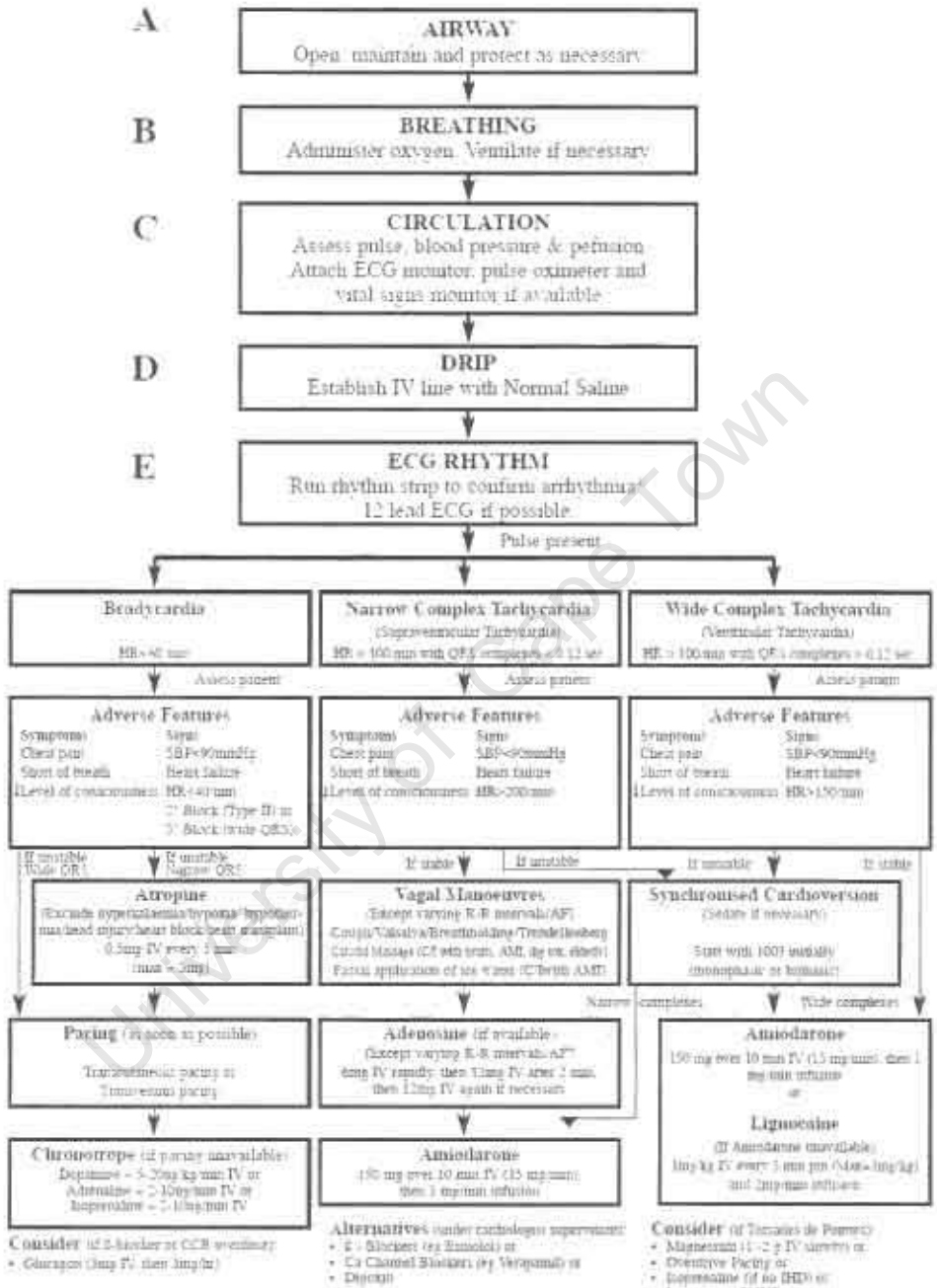
(BTE = Biphasic Truncated Exponential) (VE = Variable Escalating)

Labeling of all Defibrillators

- Labels containing Recommended Energy Settings for Manual Defibrillators are available from the Defibrillator Distributors, and should be placed on each machine (Monophasic and Biphasic). Please contact the appropriate Distributor as soon as possible to ensure that every defibrillator that you may have access to is correctly labeled.
- AED's that have been modified to comply with the latest international guidelines will be labeled "2006 Protocol Compliant". AED users are advised to follow the AED voice prompts, and to contact their AED Distributor to upgrade their device as a matter of urgency.

DEFIBRILLATOR	DISTRIBUTOR	TELEPHONE	FAX	CONTACT PERSON
Hewlett Packard / Heartstart AED	Philips Medical	011 471 5000	011 471 5384	Renier Haringh
Laerdal / Heartstart AED	Survival Technology	011 792 2190	011 793 4234	Janine O'Donnell
Physio-Control / Life-Pak	Medtronic Africa	011 677 4809	011 616 1104	Tony Soares
MRL	Welch Allyn	011 777 7555	011 777 7556	Lezanne de Koning
Nihon Kohden / Powerheart AED	Specialised Systems Electro Medical	011 444 8184	011 444 8171	Lizelle Grundell
Responder	Medhold GEMS	011 975 0633	011 975 3870	Terence Dobie
Zoll	Stat Medical	011 462 3112	011 462 3113	Tom Watson

Adult Emergency Arrhythmia Management Algorithm



(The algorithm follows the assumption that the previous step was unsuccessful and the patient is deteriorating)

*NB: SPECIALIST MEDICAL ADVICE SHOULD BE SOUGHT WHENEVER POSSIBLE.

Resuscitation Council of Southern Africa
www.resuscitationcouncil.co.za

APPENDIX C: ***EMSSA Defibrillator practice guideline***. EM008, January 2009

Emergency Medicine Society of South Africa

PRACTICE GUIDELINE
EM008

DEFIBRILLATION

This Practice Guideline details the standard of care to be employed in the use of defibrillators in both the prehospital and hospital setting.

This Practice Guideline is the minimum level of knowledge required by a healthcare provider regarding defibrillators.

Excluding the cover page, this Practice Guideline is **6** pages.

Date of publication:	January 2009
Date of review:	December 2010
Responsible committee member:	Prof Lee A Wallis

In order to safely use a defibrillator, the following applies:

*A **healthcare provider** refers to any person in the health system who may have cause to use a defibrillator during their duties, and includes Doctors, Nurses and Emergency Medical Services personnel, according to their Scope of Practice.*

Basic Life Support

Healthcare providers are to be trained in Basic Life Support, and updated in this skill at least every 2 years (and as guidelines change). Facilities are to maintain registers of staff competencies.

Indications

Healthcare providers must know the indications for the use of defibrillators in accordance with Resuscitation Council of Southern Africa algorithms. These algorithms are to be displayed next to the defibrillator at all times. These algorithms are appended to this Practice Guideline. These algorithms can be found at www.resuscitationcouncil.co.za

Usage

- All facilities must audit their defibrillators and identify them as being monophasic or biphasic, and the manufacturer recommended shock dosages.
- The institution must ensure that the recommended energy settings for that machine are clearly identified on the machine.

Healthcare providers must be able to use a defibrillator safely and efficiently. This requires knowledge of the following:

- How to operate the machine, mechanics of the defibrillator including power supply, presence of a battery, on/off switch, etc.
- Identify the required shock energy setting. Type of defibrillator (for example, monophasic or biphasic).
- How to use the paddles / pads to identify a shockable rhythm.
- How to deliver a shock safely, rapidly and effectively.
- Layout and functions of the defibrillator.
- Defibrillator capabilities (e.g. pacing).
- Correct Joule setting to be used in adults and children.
- Safety procedures before, during and after use.
- Position of paddle or pad application and appropriate defibrillator gel.
- Steps in using the defibrillator correctly.

Daily checks

A nominated post (such as lead nurse on shift) is to be responsible for daily maintenance and checks of the defibrillator. A log of daily checks must be kept on the defibrillator trolley.

The following constitute the daily check:

- Is the defibrillator plugged in?
- Is the battery charging?
- Is there adequate and spare recorder paper?
- Are ECG electrode stickers available?
- Checking cables and connectors.
- Is appropriate defibrillator conductive gel (not ultrasound or KY) available?
- Availability of pads (essential for transcutaneous pacing)
- Perform a test shock at the manufacturer's recommended test energy level, on battery power (disconnected from AC power).
- Print out and file the defibrillation test strip.

Accountability

It is the responsibility of the Health Care Institution to ensure that all Healthcare providers in their employ are trained in basic defibrillation usage, daily checking and maintenance. This knowledge is to be updated at least every 2 years.

A nominated individual is to be in charge of a log of healthcare provider training at each facility, and formal recording and filing of defibrillator daily checking and technical maintenance including battery maintenance.

MANUAL DEFIBRILLATORS : OPERATOR'S CHECKLIST

Date _____ Name _____ Location _____

Mfr/Model No. _____ Serial No. _____

At the beginning of each shift, inspect the unit. Indicate whether all requirements have been met. Note any corrective actions taken. Sign the form.

	OK as found	Corrective Action / Remarks
1. Defibrillator Unit Clean / no spills / clear of objects on top / casing intact		
2. Paddles (including paediatric*) a. Clean / not pitted b. Release from housing easily c. If internal paddles are included, verify their availability in a sterile package*		
3. Cables / Connectors a. Inspect for cracks / broken wire / damage b. Connectors engage securely and are not damaged		
4. Supplies a. Two sets of defibrillation pads in sealed packages, within expiry date* b. Monitoring electrodes c. Alcohol wipes d. Hand towel e. Scissors f. Razor g. Spare ECG paper h. Spare charged battery available* i. Gel or other conductive medium present and stored properly		
5. Power Supply a. Battery-powered units i. Verify fully charged battery in place ii. Spare charged battery available iii. Follow appropriate battery rotation schedule as per manufacturer's recommendations b. AC / battery back-up units i. Plugged into live outlet to maintain battery ii. Test on battery power and reconnect to line power		
6. Indicators / ECG Display a. Power on display b. Self-test OK* c. Monitor display functional d. "Service" message display off e. Battery charging: "low battery" light off f. Correct time displayed		
7. ECG Recorder a. Adequate ECG paper b. Recorder prints		
8. Charge-Display Cycle for Paddle or Adhesive Pad Defibrillation a. Disconnect AC plug – battery back-up units b. Charge to manufacturer's recommended test energy level c. Charge indicators working d. Discharge as per manufacturer's instructions e. Reconnect line power		
9. Pacemaker* a. Pacer output cable intact b. Pacer pads present (set of two) c. Inspect as per manufacturer's operational guidelines		
Major problem(s) identified		

* Applicable only if the unit has this supply or capacity

APPENDIX D: ***Defibrillation Questionnaire***

Defibrillation Questionnaire

Dear Doctor / Sister

Included is an anonymous and voluntary questionnaire on Defibrillators. I kindly request your help in filling of the forms as honestly and open as possible. The questionnaire forms part of a research project for my MMED degree in Emergency Medicine

Aim of Questionnaire:

The aim of the questionnaire is to gain a better understanding of the presence of defibrillators and pacing in Emergency Centres, as well an assessment of the current level of defibrillator knowledge of personnel working in the Emergency Centre.

Who should fill in the Questionnaire?

Any healthcare provider working in the Emergency Centre, including nursing personnel and doctors.

Why should you fill in the Questionnaire?

On the basis of this study, it is hoped that attention can be given to improving the standard of care around defibrillation in Emergency Centres across the Western Cape. In areas without defibrillators or pacing this study will assist in motivating for this essential equipment. In areas where personnel are lacking the necessary training or skills, these can be attended to in the form of defibrillation training.

I would like to thank you in advance for the participation in the questionnaire. Please feel free to contact me for any further information or if you wish to ask any questions.

Kind Regards

Dr Pauline Louw

Cell: 0836099600

Consent

This Defibrillation Questionnaire forms part of a research project for a MMED degree in Emergency Medicine. Although the questionnaire is anonymous and voluntary, your consent is required before participating in the questionnaire.

If you agree to participate in the questionnaire please sign the consent form below. After signing the consent form, remove the consent form from the questionnaire to ensure that it maintains anonymous.

Thank you for your participation.

Consent to participate in Defibrillation Questionnaire

I confirm that I freely agree to participate in the Defibrillation questionnaire as part of Dr Louw's research project. I have been informed on what the questionnaire involves, and I have had the opportunity to ask any questions around the study. I understand that the questionnaire will remain anonymous and confidential. I understand that refusal to participate will in no way prejudice me.

Participant signature: _____

Rank/position: _____

Name: _____

Date: _____

please mark correct box for each question

Job description	Sister	Nurse	MO / Intern	Reg / COSMO	Comments
Is there a defibrillator in the EC?	Yes	No			
Is there a defibrillator in the Hospital?	Yes	No			
Is there an Automated External Defibrillator (AED)?	Yes	No			
Are daily defibrillation tests done?	Yes	No			
Who does above?	Sr	Dr	Don't Know		
Have you had defibrillator Training?	Yes	No			
Have you used a defibrillator before?	Yes	No			
When was the last time you defibrillated?	1 week	1 month	1 year	Not sure	
Have you seen a defibrillator used before?	Yes	No			
Do you have a mono- or biphasic defibrillator?	Mono	Biphasic	Don't know		
What Joule setting do you use?			Don't know		
What are the indications for defibrillation?					
What are the indications for synchronized cardioversion?					
Are there pacing leads and pads in the EC?	Yes	No			
Are there pacing leads and pads in Hospital?	Yes	No			
Have you paced before?	Yes	No			
Have you seen pacing done before?	Yes	No			
Other Comments					

APPENDIX E: ***Hospital defibrillator information sheet***

please mark correct box for each question

				Comments
Hospital Name				
How many doctors are working in the EC?				
How many sisters in total are working in the EC?				
How many nurses in total are working in the EC?				
Is there a defibrillator in the EC?	Yes	No		
If yes, how many				
Where in the EC is the defibrillator located?				
Is there a defibrillator in the Hospital?	Yes	No		
Is there an Automated External Defibrillator (AED)?	Yes	No		
Do you have a mono- or biphasic defibrillator?	Mono	Biphasic	Both	
Are defibrillation tests done?	Yes	No		
How often are the defibrillator tests done?	Daily	Weekly	Monthly	
Who does above?	Sr	Dr		
Are above tests documented in a dedicated book?	Yes	No		
Are there pacing leads and pads in the EC?	Yes	No		
Are there pacing leads and pads in Hospital?	Yes	No		
Other Comments				

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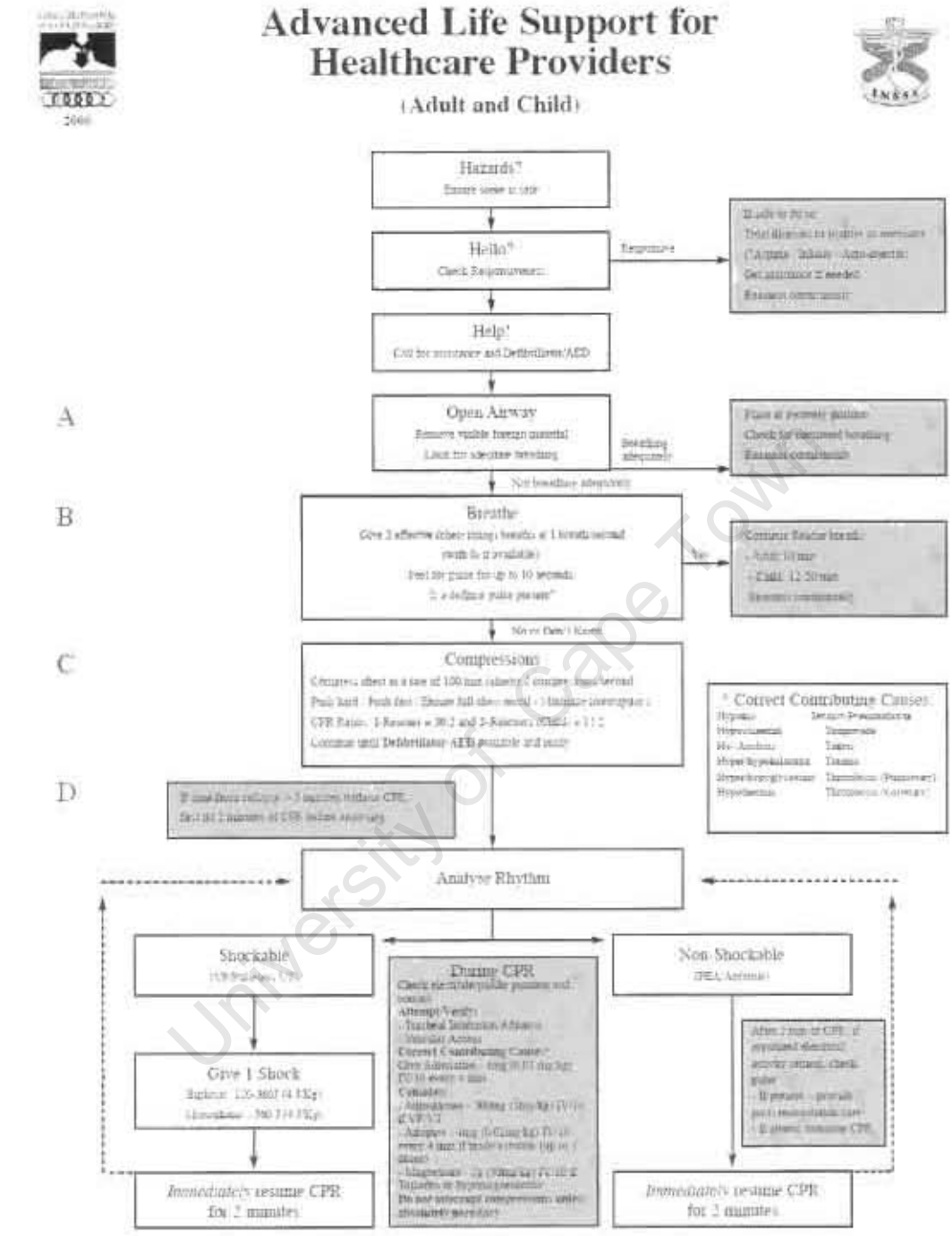
APPENDIX B: ***South African Resuscitation Council Algorithms***:



Recommended Defibrillator Energy Settings in Cardiac Arrest

(Adult and Child)

2006

Paediatric Patients (Pre-Puberty)
Monophasic & Biphasic Defibrillators - 4 Joules/kg (1st and subsequent shocks)

Adult Patients (Post-Puberty)
Monophasic Defibrillators - 360 Joules (1st and subsequent shocks)
Biphasic Defibrillators - As per Manufacturer's recommendations (See Table)

Defibrillator Make	Distributor in SA	Biphasic Waveform	Recommended Energy Setting in Cardiac Arrest (Joules)			
			1st Shock	2nd Shock	Subsequent Shock	Paed
H P / Heartstart	Philips	BTE	150 J	150 J	150 J	4 J/kg
Laerdal/Heartstart	Survival	BTE	150 J	150 J	150 J	4 J/kg
Life-Pak	Medtronic	BTE	200 J	300 J	360 J	4 J/kg
MRL	Welch Allyn	BTE	150 J	200 J	300 J	4 J/kg
Nihon Kohden	SSEM	BTE	150 J	200 J	270 J	4 J/kg
Powerheart AED	SSEM	BTE(VE)	200 J	300 J	360 J	4 J/kg
Responder	Medhold	BTE(VE)	200 J	300 J	360 J	4 J/kg
Zoll	Stat Medical	Rectilinear	120 J	150 J	200 J	4 J/kg

(BTE = Biphasic Truncated Exponential) (VE = Variable Escalating)

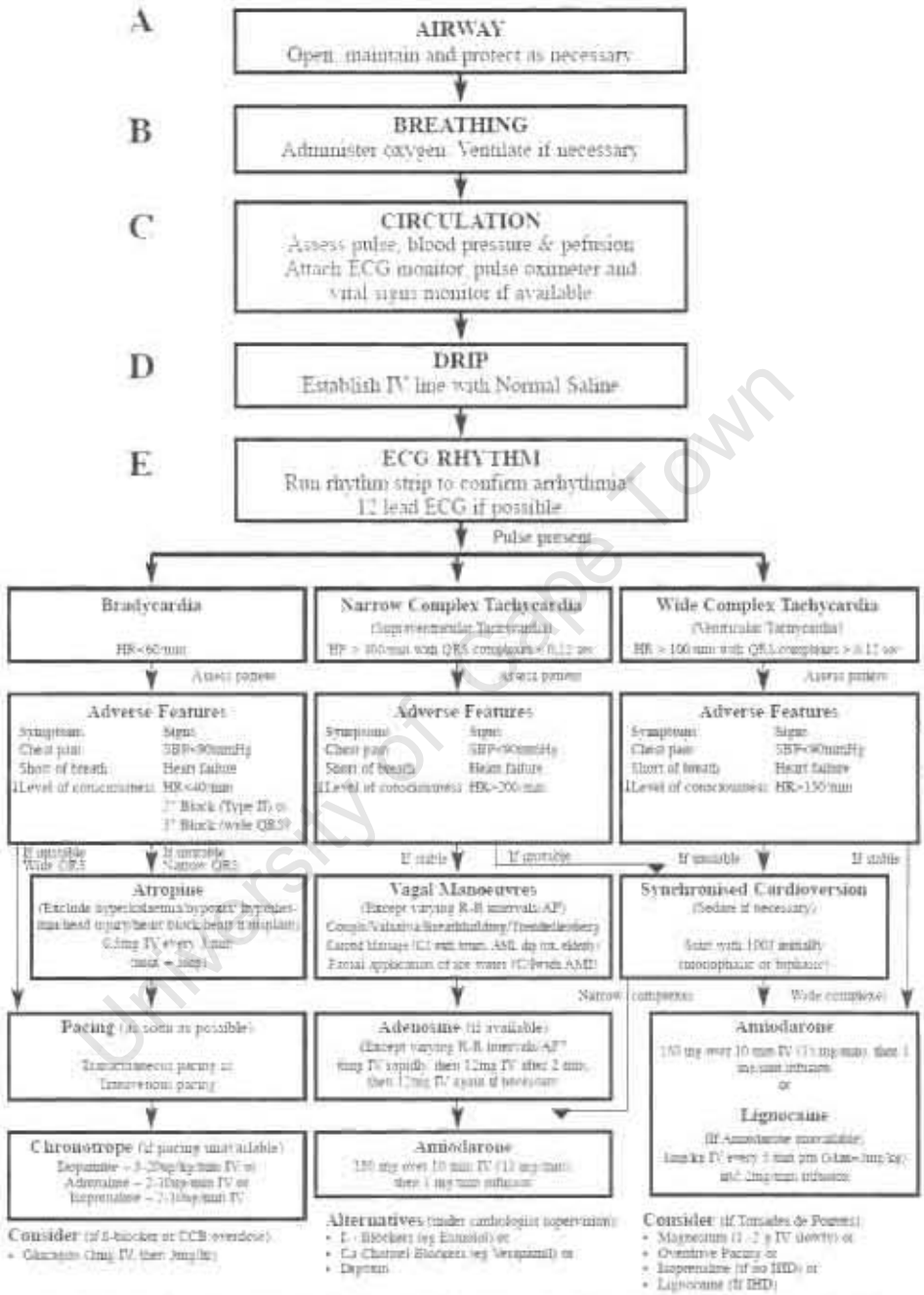
Labeling of all Defibrillators

- Labels containing Recommended Energy Settings for Manual Defibrillators are available from the Defibrillator Distributors, and should be placed on each machine (Monophasic and Biphasic). Please contact the appropriate Distributor as soon as possible to ensure that every defibrillator that you may have access to is correctly labeled.
- AED's that have been modified to comply with the latest international guidelines will be labeled "2006 Protocol Compliant". AED users are advised to follow the AED voice prompts, and to contact their AED Distributor to upgrade their device as a matter of urgency.

DEFIBRILLATOR	DISTRIBUTOR	TELEPHONE	FAX	CONTACT PERSON
Hewlett Packard / Heartstart AED	Philips Medical	011 471 5000	011 471 5384	Renier Hamingh
Laerdal / Heartstart AED	Survival Technology	011 792 2190	011 793 4234	Joanne O'Donnell
Physio-Control / Life-Pak	Medtronic Africa	011 677 4809	011 616 1104	Tony Soares
MRL	Welch Allyn	011 [illegible] 7555	011 [illegible] 7556	Lezanne de Koning
Nihon Kohden / Powerheart AED	Specialised Systems Electro Medical	011 444 8184	011 444 8171	Lizelle Grindell
Responder	Medhold GEMS	011 975 0633	011 975 3870	Terence Dobie
Zoll	Stat Medical	011 462 3112	011 462 3113	Tom Watson

Adult Emergency Arrhythmia Management Algorithm

2006



(The algorithm follows the assumption that the previous step was unsuccessful and the patient is deteriorating)

*NB: SPECIALIST MEDICAL ADVICE SHOULD BE SOUGHT WHENEVER POSSIBLE.

Resuscitation Council of Southern Africa
www.resuscitationcouncil.co.za

APPENDIX C: ***EMSSA Defibrillator practice guideline***. EM008, January 2009

Emergency Medicine Society of South Africa

PRACTICE GUIDELINE
EM008

DEFIBRILLATION

This Practice Guideline details the standard of care to be employed in the use of defibrillators in both the prehospital and hospital setting.

This Practice Guideline is the minimum level of knowledge required by a healthcare provider regarding defibrillators.

Excluding the cover page, this Practice Guideline is **6** pages.

Date of publication:	January 2009
Date of review:	December 2010
Responsible committee member:	Prof Lee A Wallis

In order to safely use a defibrillator, the following applies:

*A **healthcare provider** refers to any person in the health system who may have cause to use a defibrillator during their duties, and includes Doctors, Nurses and Emergency Medical Services personnel, according to their Scope of Practice.*

Basic Life Support

Healthcare providers are to be trained in Basic Life Support, and updated in this skill at least every 2 years (and as guidelines change). Facilities are to maintain registers of staff competencies.

Indications

Healthcare providers must know the indications for the use of defibrillators in accordance with Resuscitation Council of Southern Africa algorithms. These algorithms are to be displayed next to the defibrillator at all times. These algorithms are appended to this Practice Guideline. These algorithms can be found at www.resuscitationcouncil.co.za

Usage

- All facilities must audit their defibrillators and identify them as being monophasic or biphasic, and the manufacturer recommended shock dosages.
- The institution must ensure that the recommended energy settings for that machine are clearly identified on the machine.

Healthcare providers must be able to use a defibrillator safely and efficiently. This requires knowledge of the following:

- How to operate the machine, mechanics of the defibrillator including power supply, presence of a battery, on/off switch, etc.
- Identify the required shock energy setting. Type of defibrillator (for example, monophasic or biphasic).
- How to use the paddles / pads to identify a shockable rhythm.
- How to deliver a shock safely, rapidly and effectively.
- Layout and functions of the defibrillator.
- Defibrillator capabilities (e.g. pacing).
- Correct Joule setting to be used in adults and children.
- Safety procedures before, during and after use.
- Position of paddle or pad application and appropriate defibrillator gel.
- Steps in using the defibrillator correctly.

Daily checks

A nominated post (such as lead nurse on shift) is to be responsible for daily maintenance and checks of the defibrillator. A log of daily checks must be kept on the defibrillator trolley.

The following constitute the daily check:

- Is the defibrillator plugged in?
- Is the battery charging?
- Is there adequate and spare recorder paper?
- Are ECG electrode stickers available?
- Checking cables and connectors.
- Is appropriate defibrillator conductive gel (not ultrasound or KY) available?
- Availability of pads (essential for transcutaneous pacing)
- Perform a test shock at the manufacturer's recommended test energy level, on battery power (disconnected from AC power).
- Print out and file the defibrillation test strip.

Accountability

It is the responsibility of the Health Care Institution to ensure that all Healthcare providers in their employ are trained in basic defibrillation usage, daily checking and maintenance. This knowledge is to be updated at least every 2 years.

A nominated individual is to be in charge of a log of healthcare provider training at each facility, and formal recording and filing of defibrillator daily checking and technical maintenance including battery maintenance.

MANUAL DEFIBRILLATORS : OPERATOR'S CHECKLIST

Date _____ Name _____ Location _____

Mfr/Model No. _____ Serial No. _____

At the beginning of each shift, inspect the unit. Indicate whether all requirements have been met. Note any corrective actions taken. Sign the form.

	OK as found	Corrective Action / Remarks
1. Defibrillator Unit Clean / no spills / clear of objects on top / casing intact		
2. Paddles (including paediatric*) a. Clean / not pitted b. Release from housing easily c. If internal paddles are included, verify their availability in a sterile package*		
3. Cables / Connectors a. Inspect for cracks / broken wire / damage b. Connectors engage securely and are not damaged		
4. Supplies a. Two sets of defibrillation pads in sealed packages, within expiry date* b. Monitoring electrodes c. Alcohol wipes d. Hand towel e. Scissors f. Razor g. Spare ECG paper h. Spare charged battery available* i. Gel or other conductive medium present and stored properly		
5. Power Supply a. Battery-powered units i. Verify fully charged battery in place ii. Spare charged battery available iii. Follow appropriate battery rotation schedule as per manufacturer's recommendations b. AC / battery back-up units i. Plugged into live outlet to maintain battery ii. Test on battery power and reconnect to line power		
6. Indicators / ECG Display a. Power on display b. Self-test OK* c. Monitor display functional d. "Service" message display off e. Battery charging: "low battery" light off f. Correct time displayed		
7. ECG Recorder a. Adequate ECG paper b. Recorder prints		
8. Charge-Display Cycle for Paddle or Adhesive Pad Defibrillation a. Disconnect AC plug – battery back-up units b. Charge to manufacturer's recommended test energy level c. Charge indicators working d. Discharge as per manufacturer's instructions e. Reconnect line power		
9. Pacemaker* a. Pacer output cable intact b. Pacer pads present (set of two) c. Inspect as per manufacturer's operational guidelines		
Major problem(s) identified		

* Applicable only if the unit has this supply or capacity

APPENDIX D: ***Defibrillation Questionnaire***

Defibrillation Questionnaire

Dear Doctor / Sister

Included is an anonymous and voluntary questionnaire on Defibrillators. I kindly request your help in filling of the forms as honestly and open as possible. The questionnaire forms part of a research project for my MMED degree in Emergency Medicine

Aim of Questionnaire:

The aim of the questionnaire is to gain a better understanding of the presence of defibrillators and pacing in Emergency Centres, as well an assessment of the current level of defibrillator knowledge of personnel working in the Emergency Centre.

Who should fill in the Questionnaire?

Any healthcare provider working in the Emergency Centre, including nursing personnel and doctors.

Why should you fill in the Questionnaire?

On the basis of this study, it is hoped that attention can be given to improving the standard of care around defibrillation in Emergency Centres across the Western Cape. In areas without defibrillators or pacing this study will assist in motivating for this essential equipment. In areas where personnel are lacking the necessary training or skills, these can be attended to in the form of defibrillation training.

I would like to thank you in advance for the participation in the questionnaire. Please feel free to contact me for any further information or if you wish to ask any questions.

Kind Regards

Dr Pauline Louw

Cell: 0836099600

Consent

This Defibrillation Questionnaire forms part of a research project for a MMED degree in Emergency Medicine. Although the questionnaire is anonymous and voluntary, your consent is required before participating in the questionnaire.

If you agree to participate in the questionnaire please sign the consent form below. After signing the consent form, remove the consent form from the questionnaire to ensure that it maintains anonymous.

Thank you for your participation.

Consent to participate in Defibrillation Questionnaire

I confirm that I freely agree to participate in the Defibrillation questionnaire as part of Dr Louw's research project. I have been informed on what the questionnaire involves, and I have had the opportunity to ask any questions around the study. I understand that the questionnaire will remain anonymous and confidential. I understand that refusal to participate will in no way prejudice me.

Participant signature: _____

Rank/position: _____

Name: _____

Date: _____

please mark correct box for each questior

Job description	Sister	Nurse	MO	Reg
			Intern	COSMC

Comments

Is there a defibrillator in the EC?	Yes	No		
Is there a defibrillator in the Hospital?	Yes	No		
Is there an Automated External Defibrillator (AED)?	Yes	No		
Are daily defibrillation tests done?	Yes	No		
Who does above?	Sr	Dr	Don't Know	
Have you had defibrillator Training?	Yes	No		
Have you used a defibrillator before?	Yes	No		
When was the last time you defibrillated?	1 week	1 month	1 year	Not sure
Have you seen a defibrillator used before?	Yes	No		
Do you have a mono- or biphasic defibrillator?	Mono	Biphasic	Don't know	
What Joule setting do you use?			Don't know	
What are the indications for defibrillation?				
What are the indications for synchronized cardioversion?				
Are there pacing leads and pads in the EC?	Yes	No		
Are there pacing leads and pads in Hospital?	Yes	No		
Have you paced before?	Yes	No		
Have you seen pacing done before?	Yes	No		
Other Comments				

APPENDIX E: ***Hospital defibrillator information sheet***

please mark correct box for each question

				Comments
Hospital Name				
How many doctors are working in the EC?				
How many sisters in total are working in the EC?				
How many nurses in total are working in the EC?				
Is there a defibrillator in the EC?	Yes	No		
If yes, how many				
Where in the EC is the defibrillator located?				
Is there a defibrillator in the Hospital?	Yes	No		
Is there an Automated External Defibrillator (AED)?	Yes	No		
Do you have a mono- or biphasic defibrillator?	Mono	Biphasic	Both	
Are defibrillation tests done?	Yes	No		
How often are the defibrillator tests done?	Daily	Weekly	Monthly	
Who does above?	Sr	Dr		
Are above tests documented in a dedicated book?	Yes	No		
Are there pacing leads and pads in the EC?	Yes	No		
Are there pacing leads and pads in Hospital?	Yes	No		
Other Comments				

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